

# ANNALS of SURGERY

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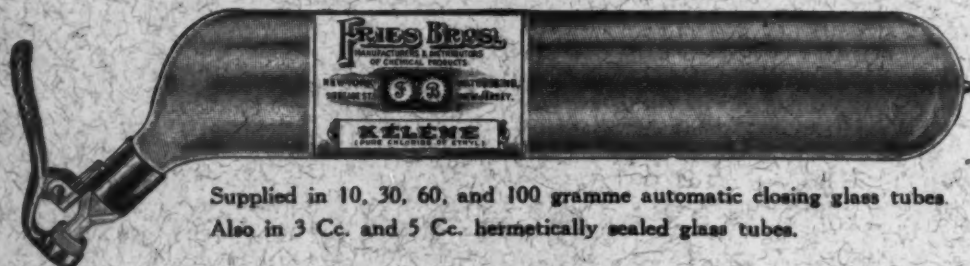
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# ANNALS *of* SURGERY

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## CONCEALED CANCER OF THE TONGUE\*

BY WILLIAM F. MACFEE, M.D.

OF NEW YORK, N. Y.

IN SPITE of the fact that the tongue is an accessible organ, there is a discouraging number of failures to recognize early lingual cancer. Delinquency on the part of the patient is sometimes responsible, but with increasing public education on the subject of cancer the patient is becoming less frequently to blame. An impressive number of failures must be attributed to the medical profession.

Diagnostic failures come about in two ways. First, the lesion is discovered but not recognized as being cancer. It is mistaken for some benign condition, such as an aphthous ulcer, syphilis, or a traumatic lesion. This is a large and interesting group but must be omitted from the present discussion. We are now concerned with another group in which the lesion is not discovered. It is not discovered because it is partly concealed and because the symptoms are not recognized as pointing to the tongue. Of seventy cases reviewed in the preparation of this paper a little more than 20 per cent. belonged to this group.

There are two clinical types of cancer of the tongue which may be called concealed. There is the type which conforms to the classical descriptions of cancer but which escapes detection because of its situation. Cancers of this kind are located far back on the tongue, usually in its pharyngeal portion. Favorite sites are those at which there is angulation of the lingual mucous membrane as it merges into the mucosa of adjacent structures, as at the base of the pharyngeal tonsil or of the tonsillar sinus, at the lingual attachment of the glosso-palatine arch, in the valleculæ, or at the glosso-epiglottic fold. The other clinical type of concealed cancer escapes detection because it is almost completely buried in the substance of the tongue. This type is nearly always in the posterior half or two-thirds of the tongue and is found most often on the inferior surface of the oral portion of the tongue where its mucous membrane reflects onto the floor of the mouth. Fitzwilliams<sup>1</sup> describes varieties of it as the indurated plaque and the nodulated induration. It differs most strikingly from the usual conception of lingual cancer. Cancer of the tongue is most often described as a foul, irregular ulcer, with uneven and sloughy floor and with rolled-out, hardened edges. On the contrary, the external ulcer of the infiltrating type of concealed cancer may be very small, or indeed missing, whereas the tumor mass may be large and deeply invading. There is usually a slight dimple, or pucker in the mucous membrane over the most superficial part of the tumor.

\* Read before the New York Surgical Society, October 8, 1930.

Here there may be a slight loss of epithelium or it may be intact. Often there is a slight pallor of the surrounding mucous membrane. Just why there should be such deep invasion with so little external ulceration is not apparent. Histologically, the tumor is squamous-celled and not of adenomatous origin. This form of cancer may involve a large part of the tongue before it is discovered by either the patient or his physician.

The two types of hidden cancer just described are not usually detected in the course of a routine clinical history and examination. The symptoms of early cancer of the tongue are not those of advanced cancer. It is unfortunate that pain in the tongue is still listed as an important symptom of cancer. Pain is very likely not to be an early symptom. This is particularly

true if the lesion is located in the less sensitive posterior portion of the tongue. In general, it may be said that there is a striking absence of early symptoms which point directly to the tongue. Such symptoms as are present may be more or less indirect and therefore misleading. A routine examination of the tongue may also be fruitless. A cancer situated far back on the tongue, even if ulcerated, is not seen unless the laryngeal mirror is used. A cancer lying almost wholly within the substance of the tongue likewise escapes observation, even when the tongue is thrust far out. Having the patient elevate the tongue may reveal suggestive signs if the growth is well forward. When, however, it is in the posterior half or two-thirds, raising the tongue merely serves to further obscure the growth, because when actively elevated the



FIG. 1.—Showing depression over the centre of the lesion under the tongue; mucous membrane is intact.

tongue is automatically retracted at the same time.

The palpating finger is much more reliable than the eye in detecting cancer of the tongue. If the tongue is relaxed during the examination, an indurated area, unless it is very far back, will nearly always be felt. If, however, the tongue is thrust out, its muscles are hard and a zone of induration may be missed. Valuable as the procedure is in the discovery of cancer, palpation of the tongue is not ordinarily done by the examining physician, unless something is suspected. The patient likewise rarely touches his tongue with the finger unless he senses some change in it, and it is surprising how large a growth in the posterior part of the tongue may become without giving appreciable local symptoms. The following case histories are illuminating:

## CONCEALED CANCER OF THE TONGUE

CASE I.—Hosp. No. 79423. White, female, thirty-seven years old. About August 1, 1929, the patient began to notice that when drawing her tongue in she had "an unnatural sensation" in the posterior part of it. Soon afterward, perhaps a few weeks, she developed several "canker sores" on the left side of her tongue and on the inside of her left cheek. She consulted a surgeon who made a microscopic examination and found that she had Vincent's angina. The lesions were treated locally with an arsenical solution applied with cotton for an hour or so at a time. Treatment in this manner was continued for three or four months. All of the sores healed and the patient felt well except that she had considerable pain in the back of the tongue when she yawned.

About a month later she developed a blister-like pus pocket in the region of the left tonsil. She was seen by a second surgeon who incised it. There was a good deal of bleeding but the patient did not see any pus. The wound seemed to heal, but about two weeks afterward the patient began to have a sticking pain in the left ear, pain in the left side of the head, and along the left lower jaw. Soon a swelling appeared in the left posterior portion of the tongue very near the tonsil. White patches developed about this area, on the tonsil, tongue, and soft palate. The tongue became hard and "knotted up" so she could not use it. Further examinations by a number of surgeons confirmed the original diagnosis of Vincent's angina. Intravenous treatment was carried out but no improvement resulted. After one month the swollen area was incised. This was followed by further intravenous treatments and local applications. The condition became rapidly worse. The patient was sent to a sixth surgeon whose description of the lesion follows:

"There is a triangular ulcer on the under surface of the left border of the tongue opposite the first and second molar teeth. This is an inverted triangle in shape, 1 by .5 centimetres in diameter. It has a clean, red surface and a low border. From this start there has been an invasion into the tongue substance posteriorly through the entire left half of the tongue as far as the epiglottis. In this latter region the infiltration has broken through the surface to form a typical cancerous ulcer 1.5 centimetres in diameter. The left soft palate shows invasion which is continuous with an induration about the left tonsil, but the recent incision at the tonsil may have been followed by an inflammatory reaction to which the tonsillar induration could be ascribed. The infiltration of the tongue definitely limits the degree of motion. Apparently there has been an extension beyond the region of the tongue itself except that in the soft palate. The sub-maxillary and deep jugular chains of lymph-nodes are involved. The condition is wholly inoperable."

The diagnosis of cancer was confirmed by biopsy and palliative radiation instituted. The patient died two months after the diagnosis was made and ten months after the onset of symptoms. In this case Vincent's angina may have preceded or have been subsequent to the onset of carcinoma. It is evident that attention was so completely centered on the infectious process that the cancer was overlooked.

CASE II.—Hosp. No. 70050. White, male, fifty-one years old. For about six weeks the patient has suffered from almost constant pain in the upper abdomen. The pain is severe and radiates across both sides of the abdomen, to the lower anterior chest, and to the back in the region of the shoulders. The pain is not definitely related to meals but usually comes on within a few minutes after he has eaten and lasts for two or three hours. The patient has often felt as if something prevented food from passing through his stomach. He also has some discomfort in the throat when swallowing, and now takes nothing but soft food and liquids.

In addition to this stomach trouble the patient has had persistent neuralgia in the left side of the face and jaw, the left side of the head, and in the left ear. He sometimes feels as if someone were jabbing an icepick in his ear.

*Past history.*—No history of venereal disease; is a heavy smoker of pipe and cigars; alcoholic stimulants in moderation.

*Family history.*—No malignant disease.

*Examination.*—The mucous membranes of the mouth are of good color. Teeth



WILLIAM F. MACFEE

sound, except for some peri-dental gingival infection. Tonsils small, pharynx slightly injected. The protruded tongue deviates slightly to the left. No palpable lymph-nodes in the neck. Heart and lungs negative. Abdomen negative. Genitalia negative. Patellar reflexes diminished.

*Laboratory findings.*—Urine negative. Blood Wassermann negative. *Radiographic findings.*—Barium meal. Pylorus and duodenum negative. Some constant irregularity of the cardiac portion of the stomach suggestive of a defect. No six-hour retention.

*Laryngeal examination.*—The laryngeal box is tremendously large but anatomically and physiologically normal. There is a swelling beneath the left side of the tongue about the level of the last molar. The tongue deviates to the left. Suggest X-ray with the possibility of finding a stone in the submaxillary gland.

*X-ray report.*—No evidence of stone in submaxillary gland.

*Neurological examination.*—Pupils small and slightly irregular, react to light and accommodation. The tongue deviates to the left because of fixation to the floor of the



FIG. 2.—Longitudinal section through the tongue of patient shown in Fig. 1. Note deep invasion toward center of tongue. An area of cystic degeneration is seen toward the tip.



FIG. 3.—Showing cancer invading tongue. Mucous membrane intact.

mouth. Left knee-jerk sluggish, right absent. Ankle jerks not obtained. No Romberg. The probability of an early tabes must be confirmed by spinal puncture.

On December 19, 1928, eight days after admission to the hospital, a more careful examination of the tongue revealed a hard tumor imbedded in the left half of it opposite the second molar. It seemed fixed in the substance of the tongue and was slightly sensitive to pressure. Inspection of the surface of the tongue revealed a little flattening on the dorsum overlying the tumor. The left inferior lateral surface of the tongue near the reflexion on the floor of the mouth showed an area .5 centimetres in diameter over which the mucous membrane was slightly retracted and fixed to the tumor. There was no ulceration, but the area had a slightly rough, or granular surface with a little grayish stipling. The patient was unaware of the presence of the tumor but after its discovery remembered that the tongue had recently "felt a little raw as if it had been scraped."

A diagnosis of cancer was made and on December 24, 1928, a hemiglossectomy was done. This was followed by excision of the lymph-nodes of the neck on both sides. No involvement was reported. The patient is well at the present time.

In this case the chief complaint was upper abdominal pain which radiated to the lower, anterior chest and to the posterior shoulder regions. This

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very misleading symptom disappeared immediately after removal of the lingual carcinoma and has not returned—now nearly two years after operation. We may conclude therefore that the pain in this case was not due to a peptic ulcer, for example, but to cancer of the tongue and that it was referred to areas of vagus distribution. It is noteworthy that this symptom is mentioned in only one other case of the group studied. We are reminded that the jugular ganglion of the vagus communicates with the petrous ganglion of the glosso-pharyngeal nerve by an inconstant branch (see diagram).

When cancer is located in the posterior half of the tongue one of the first and most consistent symptoms is pain in or about the ear and rarely in the tongue itself. It is interesting that pain which presumably has its origin in the tongue is so constantly referred to the ear. In glosso-pharyngeal neuralgia, as described by Doyle,<sup>2</sup> Adson,<sup>3</sup> Dandy,<sup>4</sup> and others, pain in the ear is one of the most constant and most prominent symptoms. It would seem, therefore, that painful disturbances of the glosso-pharyngeal nerve tend to be referred to the ear. The tympanic branch of the glosso-pharyngeal is generally believed to be responsible.

Pain in the general region of the external ear may be explained in a similar manner. Harris<sup>5</sup> has pointed out that the sensory nerve supply in this region is very complex. No less than four cranial nerves take part in it. (See diagram) He gives them as: (1) The auriculo-temporal branch of the third division of the fifth nerve; (2) sensory branches from the geniculate ganglion of the facial, or seventh nerve; (3) Jacobson's nerve from the glosso-pharyngeal, or ninth pair; and (4) Arnold's nerve from the tenth or vagus. Since all of these cranial nerves inter-communicate, pain arising from the tongue and referred to the ear and thereabout may readily be accounted for.

The symptom next in importance to pain in the ear is a certain amount of what patients refer to as awkwardness of the tongue. By this is meant some disability in swallowing, in dislodging particles of food from the teeth, and occasionally there is some clumsiness of the tongue in speech. This probably is due in part to replacement of muscle by tumor tissue and sometimes to motor-nerve involvement.

A third symptom often mentioned or elicited is a queer, unnatural, or tickling sensation in the involved side of the tongue. This is likely due to sensory nerve disturbance.

These three symptoms, pain in and about the ear, motor disturbances, and painless sensory disturbances of the tongue, are to be emphasized as among the earliest and therefore the most important symptoms of cancer of the tongue. Salivation, pain in the tongue itself, fetor, and all of the text-book symptoms eventually appear, but by the time they are present the condition usually is hopeless.

The signs of concealed cancer of the tongue are often overlooked unless

cancer is suspected. Hints of its presence, however, may be derived from the following:

1. When the patient protrudes the tongue far out there is a tendency for it to deviate slightly toward the side of the lesion. (See photograph.) This is due in part to replacement of lingual muscle by tumor tissue and partly to terminal motor-nerve involvement which produces an incomplete paralysis of the affected side of the tongue.
2. Often a slight dimpling, furrowing, flattening, or other evidence of retraction of the surface mucous membrane may be seen.
3. Occasionally it is possible to detect a slight defect in the patient's speech. This results from mechanical disability of the tongue.
4. Inspection may reveal a minute ulcer at the most superficial point of

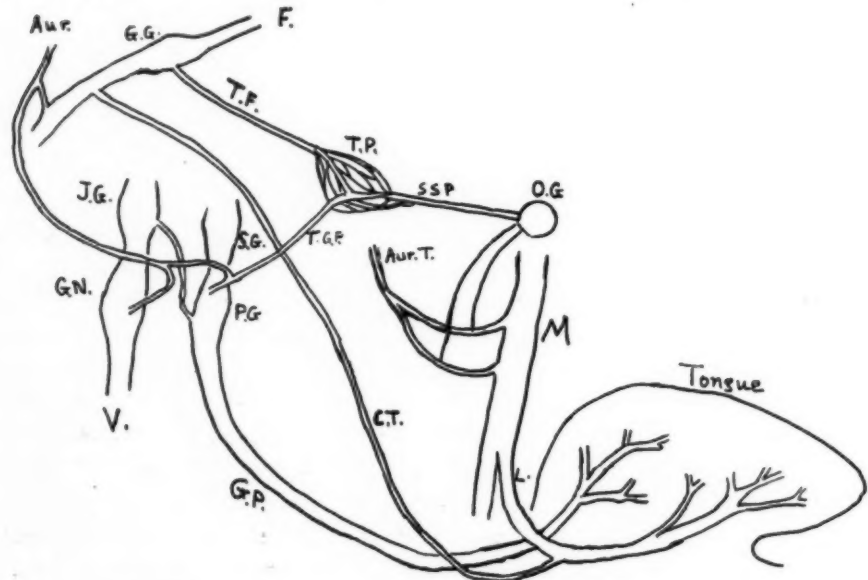


FIG. 4.—Schematic illustration of sensory nerve supply of tongue various communications. F.—Facial nerve. V.—Vagus. G.P.—Glosso-pharyngeal. M.—Mandibular division of the trigeminal. T.P.—Tympanic branch of facial. S.S.P.—Smaller superficial petrosal. T.G.P.—Tympanic branch of the glosso-pharyngeal. O.G.—Otic ganglion. Aur.—Auricular branch of vagus with communicating twig from sensory root of facial. Aur. T.—Auriculo-temporal branch of the mandibular. C.T.—Chorda tympani. J.G.—Jugular ganglion of the vagus. G.N.—Ganglion nodosum of vagus. S.G.—Superior ganglion of glosso-pharyngeal. P.G.—Petrous ganglion of glosso-pharyngeal.

an infiltrating cancer. Lesions of the pharyngeal portion of the tongue may be revealed by the laryngeal mirror.

5. Palpation properly done will nearly always reveal an area of induration.
6. Too frequently, enlarged, hard, lymph-nodes in the neck constitute the first observed sign of cancer of the tongue. Even then the primary lesion may be missed. We have records of such cases in which the teeth and tonsils have been vigorously attacked, the cancer in the meantime being overlooked.
7. The signs of advanced cancer of the tongue are too obvious to require discussion.



## CONCEALED CANCER OF THE TONGUE

Once an ulcerated or indurated area is discovered in the tongue of an adult man or woman, diagnosis should not long be delayed. The possibility of cancer should be seriously considered from the start and should not be dismissed until the lesion is proved not to be cancer. When doubt exists biopsy should be done, care being taken to include the margin of the lesion. A piece of sufficient size to insure good sections should be taken. The advantages of such a biopsy far outweigh the possibility of harm. The danger of dissemination of cancer of the tongue through a biopsy properly done has not been proven. Roux-Berger and Monod<sup>6</sup> state that biopsy has been done on 825 cases of cancer of the tongue at the Curie Institute without evidence of an aggravation of the disease.

If radical treatment of a lesion is under consideration, histological proof of its character should be established. Regaud<sup>7</sup> considers biopsy an indispensable part of the treatment of cancer of the tongue. He points out that it is no longer a manifestation of scientific curiosity, but rather an obligation on the part of the physician, and something which is due the patient. Clinical diagnosticians are sometimes wrong. In a little more than 5 per cent. of the cases reviewed, benign lesions, most often tuberculous ulcers, were mistaken for cancer.

Treatment of concealed cancer of the tongue does not differ in principle from that of cancer of the tongue in general except insofar as it may be influenced by the position of the tumor. Opinion is divided as to the relative merits of surgery and radium. Regardless of the agency used to destroy the local growth, however, any treatment of cancer of the tongue must include the regional lymph-nodes. This was emphasized years ago by Küttner.<sup>8</sup> The extent of adequate surgical treatment of cancer of the tongue has been logically presented in a recent work by Semken.<sup>9</sup> The radiological treatment has been fully described by Regaud,<sup>10</sup> Lacassagne,<sup>11</sup> Roux-Berger and Monod,<sup>12</sup> and, in this country, by Quick.<sup>13</sup>

Whatever treatment is elected must be thorough if it is to be effective. The first treatment is the decisive treatment. Recurrent cancer of the tongue, either local or in the regional lymph-nodes, is rarely cured by any method. The responsibility attached to the first treatment is considerable.

The prognosis in concealed cancer of the tongue is generally worse than that of the more obvious forms. This is not because of any biological peculiarity of the tumor but because late discovery and its usual proximity to structures adjacent to the tongue contribute to make it bad. The principal hope lies in earlier recognition and better treatment.

### SUMMARY

1. Cancer of the tongue in about 20 per cent. of the cases is anatomically situated in such a way that it escapes early detection.
2. Frequently, it is further obscured by the absence of symptoms, or by the presence of symptoms which are indirect and consequently liable to misinterpretation.

3. An attempt has been made to call attention to certain symptoms and signs which should suggest the possible presence of lingual cancer, and thereby lead to its earlier discovery.

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## TRAUMATIC PECTUS EXCAVATUM\*

By JOHN ALEXANDER, M.D.

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THE operative technics used in two cases of pectus excavatum are presented because there has not been, so far as I am aware, any previous report of operation performed for the traumatic chronic type of this deformity.

Trauma severe enough to fracture the flexibly suspended sternum is frequently fatal owing to this or associated injury. Malposition of fresh frac-



FIG. 1.—*Left:* Great depression of sternum and right ribs as a result of contraction in a chronic empyema in a child. *Right:* Symptomless pectus excavatum that patient believes has been present since birth (photograph shown through the courtesy of Dr. Reed Nesbit).

tures may be corrected by posture, traction through hooks or by open operation, but prevention of recurrence of deformity may be difficult because the fracture gives the constant in-pulling action of the normal negative intra-thoracic pressure an advantage which it does not possess when there is no break in continuity of the thoracic cage. A sprain of several sterno-chondral and costo-chondral joints without actual fracture of sternum, cartilages or

\* Read before the American Therapeutic Society, June 21, 1930.



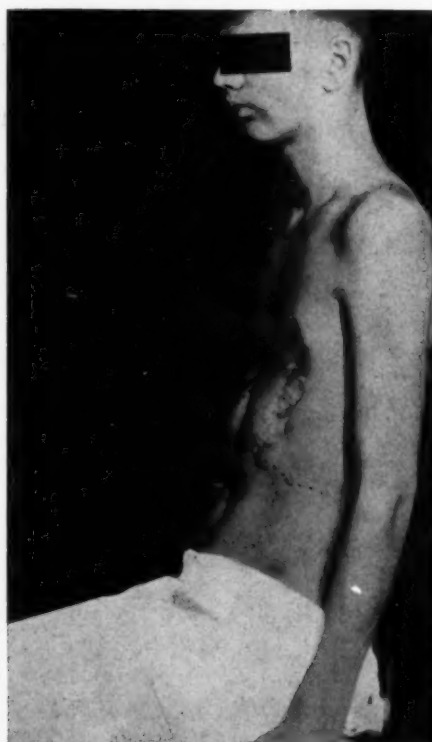
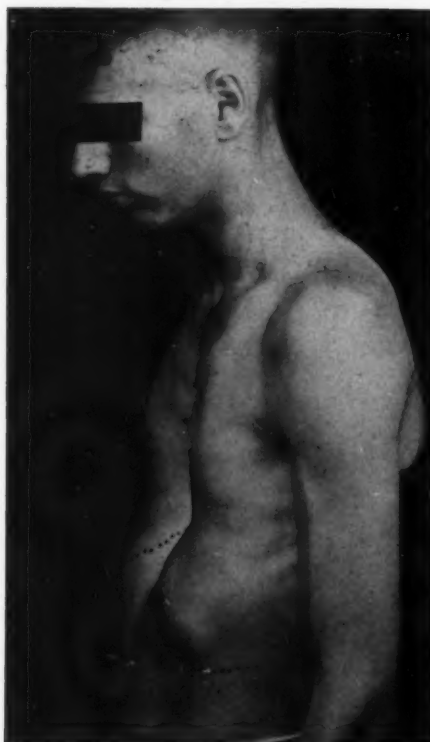
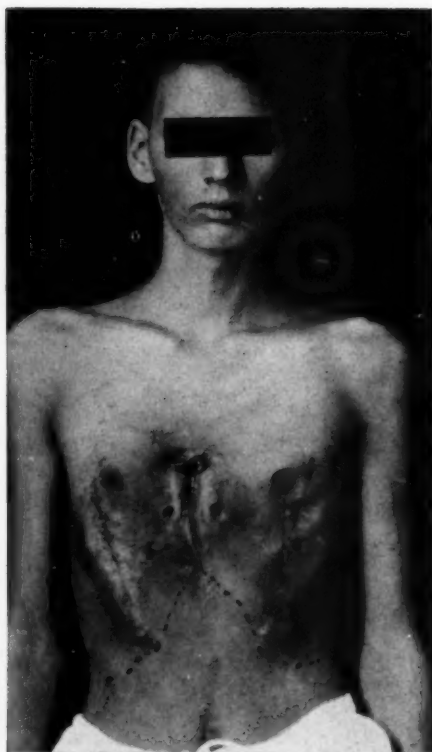


FIG. 2.—Case I. Before and after operation. The open wounds closed soon after photographs were taken.

### TRAUMATIC PECTUS EXCAVATUM

ribs gives the in-pulling action of the negative intra-thoracic pressure a similar, though perhaps, lesser advantage in causing abnormal depression of the sternum. So does rickets or the undue plasticity of the thoracic cage of some infants and youths. I now have as a patient a boy of twelve years of age with a great but symptomless depression of the sternum which is secondary to the fibrous contraction of a chronic tuberculous empyema (Fig. 1). Nageotte-Wilbouchewitch<sup>1</sup> found that 10 per cent. of 200 debilitated infants whom she studied showed inspiratory sinking in of the sternum.

The commonest type of pectus excavatum is the congenital (Fig. 1). In 1911 Ludwig Meyer<sup>2</sup> operated in such a case, resecting 2.5 centimetres of the

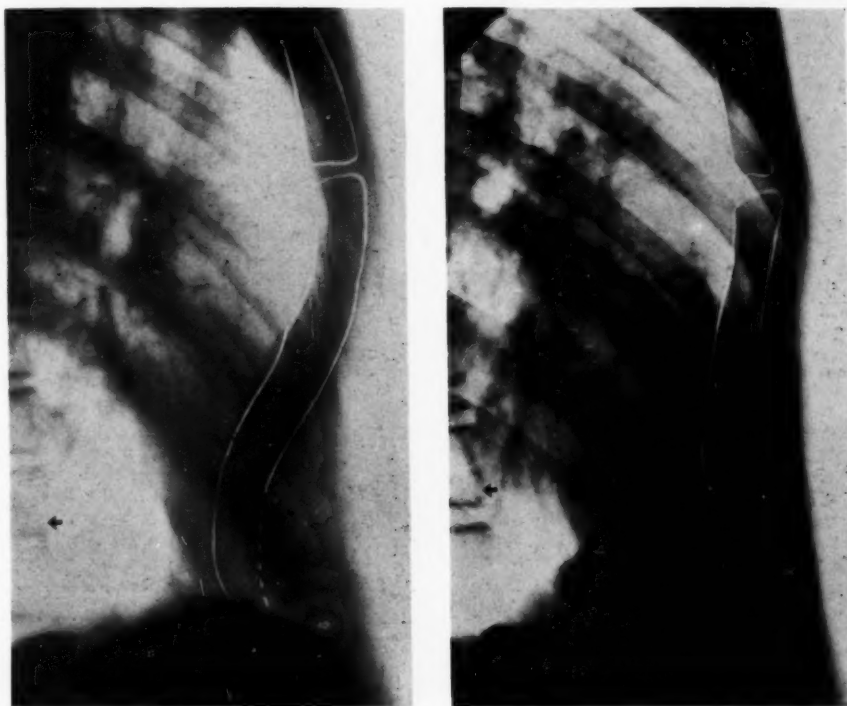


FIG. 3.—Case I. Lateral roentgenograms before and after operation. The sternal outlines have been reinforced with pencil. Note proximity of sternum and spine before operation. The black arrows indicate the anterior surfaces of the vertebræ. (See Fig. 4.)

second and third right costal cartilages; the patient was said to have lost his dyspnoea. Sauerbruch,<sup>3</sup> realizing that so incomplete an operation could not be expected to cure, resected 3 centimetre sections of the fifth to the ninth, inclusive, left costal cartilages and the left part of the sternum below the fourth cartilage. The patient was relieved of his dyspnoea and palpitation and was able to work from twelve to fourteen hours a day. In his second patient Sauerbruch resected the fourth to sixth left cartilages and the corresponding left half of the sternum and placed in the wound a fat graft from the thigh to protect the heart. The patient was relieved of dyspnoea and asthmatic attacks. Should symptoms recur, Sauerbruch would remove the

right costal cartilages but would leave the right half of the sternum. Hoffmeister<sup>4</sup> reports an operation by Lexer for congenital pectus excavatum in which the fifth to ninth cartilages on both sides were divided and the corresponding portion of the sternum dissected free. His intention was to turn over the concave sternum and replace it, but as there was a 1.5 centimetre gap between the divided ends of the cartilages on each side he removed the sternal piece.

It is a surprising but well-known fact that it is rare for even severe degrees of congenital pectus excavatum to present symptoms sufficiently troublesome even to suggest the use of surgery. Mild dyspnoea on exertion

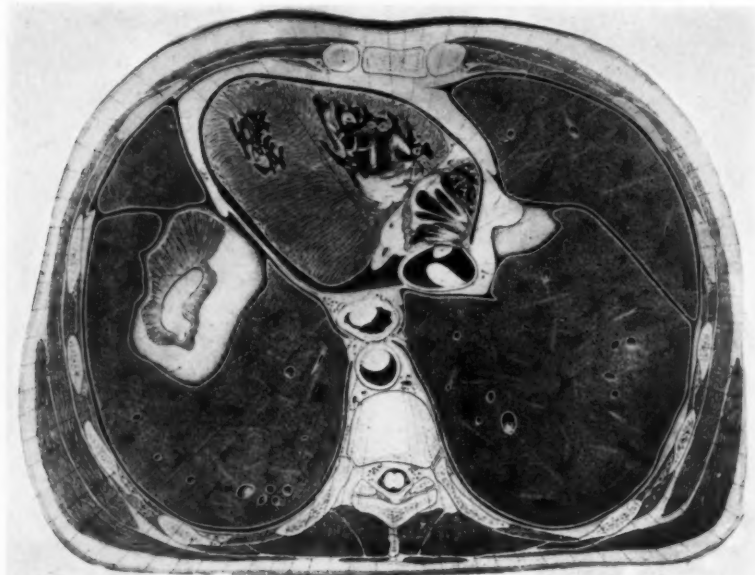


FIG. 4.—Transverse section of a normal thorax through the fourth costal cartilages and eighth vertebral body. The compressing effect of such lessening of the distance between sternum and spine as exists in the pre-operative röntgenograms of Figs. 3 and 8 is apparent in this drawing. (From Eycleshymer and Schoemaker: *A Cross-Section Anatomy*. D. Appleton and Co.)

may be the only symptom. Pohl<sup>5</sup> has described an actual impression made upon the heart by a depressed sternum. In cases in which the sternum closely approaches the anterior surfaces of the vertebræ, the heart is often found to have been pushed entirely into the left hemithorax. Changes in the position of the heart have been discussed by Stadtmüller<sup>6</sup> and Rösler.<sup>7</sup>

Severe symptoms, when present, may be dyspnoea, agonizing oppression or pain in the cardiac region or referred therefrom, palpitation and disturbance of cardio-circulatory function. Occasionally patients are seen whose symptoms are sufficiently disturbing or disabling to require operation.

CASE I.—A boy of sixteen was referred by Dr. Nap Chaignon, of Port Austin, Michigan, and was admitted on July 17, 1929, to the University of Michigan Hospital complaining of increasing pain and depression in the sternal region. While wrestling four years before, his lower sternum was injured by heavy pressure. There was some



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pain, but not severe enough to require a physician; no deformity was noted at that time. The pain ceased but during the next three years the lower sternum gradually became depressed and during the last year the depression has progressed rather rapidly, and increasing local pain has caused him to stop work as a bellboy. There are now some dyspnoea and occasional dysphagia but no other gastro-intestinal nor cardio-circulatory symptoms.

Examination revealed a deep symmetrical depression of the lower half of the sternum and adjoining cartilages, the deepest point being opposite the end of the sixth cartilage (Figs. 2 and 3). The depression held 70 cubic centimetres. Respiratory movement was free at all levels. Both costal margins just mesial to the mid-clavicular lines were markedly buckled. The heart by percussion and röntgen ray was unenlarged but was displaced 3 centimetres to the left. Cardiac sounds and rate normal, pulses equal, blood

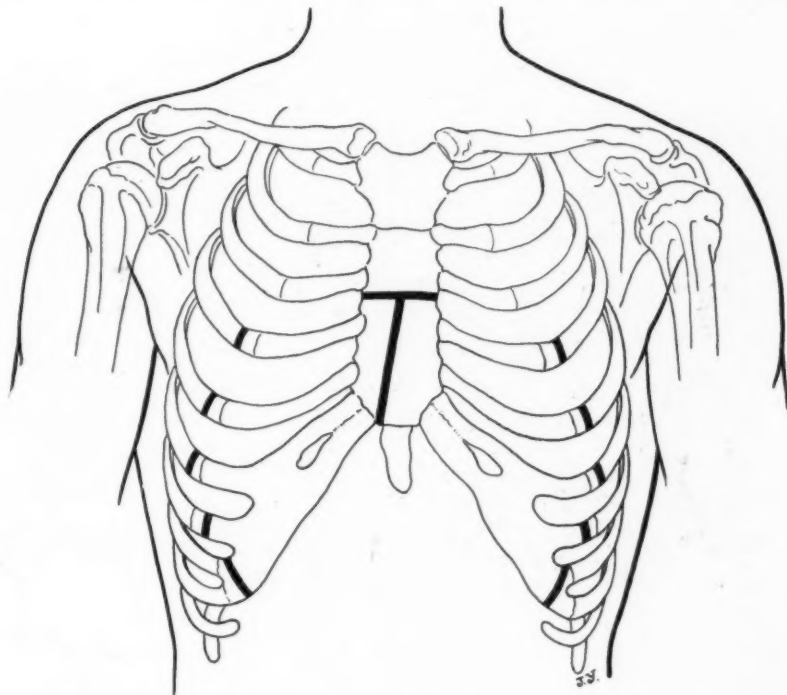


FIG. 5.—Case I. Heavy lines indicate places of operative division of sternum, ribs and cartilages. Not until all of these divisions had been made was it possible to reduce the deformity.

pressure 115/80, no cyanosis. The liver edge was 2 centimetres below the right costal margin. No abnormal pulmonary findings, no clubbing of fingers. A large barium-gelatin bougie passed freely through the oesophagus.

The progressive and disabling character of the pain and deformity seemed to justify an attempt at operative relief. On July 30 I operated (Fig. 5) under nitrous oxide anaesthesia. A short transverse incision was made over the sternum at the level of the third intercostal space and the sternum was transversely divided. A short incision was then made through the upper linea alba to the peritoneum and a finger was introduced through the interval between the right zipho-costal origins of the diaphragm to the posterior surface of the lower sternum; an attempt to lift it forward was without the least effect. Next, the fourth, fifth and sixth ribs were divided subperiosteally just lateral to their costo-chondral junctions, rather than through their cartilages, because actual bony union of these divisions was desired in order to make permanent the operative

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reduction of the deformity. A further attempt to lift the sternum forward was fruitless. Next, the seventh, eighth and ninth cartilages of both sides were divided, and still the sternum could not be lifted forward. In view of this experience I do not understand how Zahradniček<sup>8</sup> obtained a satisfactory result in his case of an old pectus excavatum from merely exercising traction upon two wires introduced through operative perforations in the sternum.

Next, the sternum was divided longitudinally from the right of the xiphoid to the

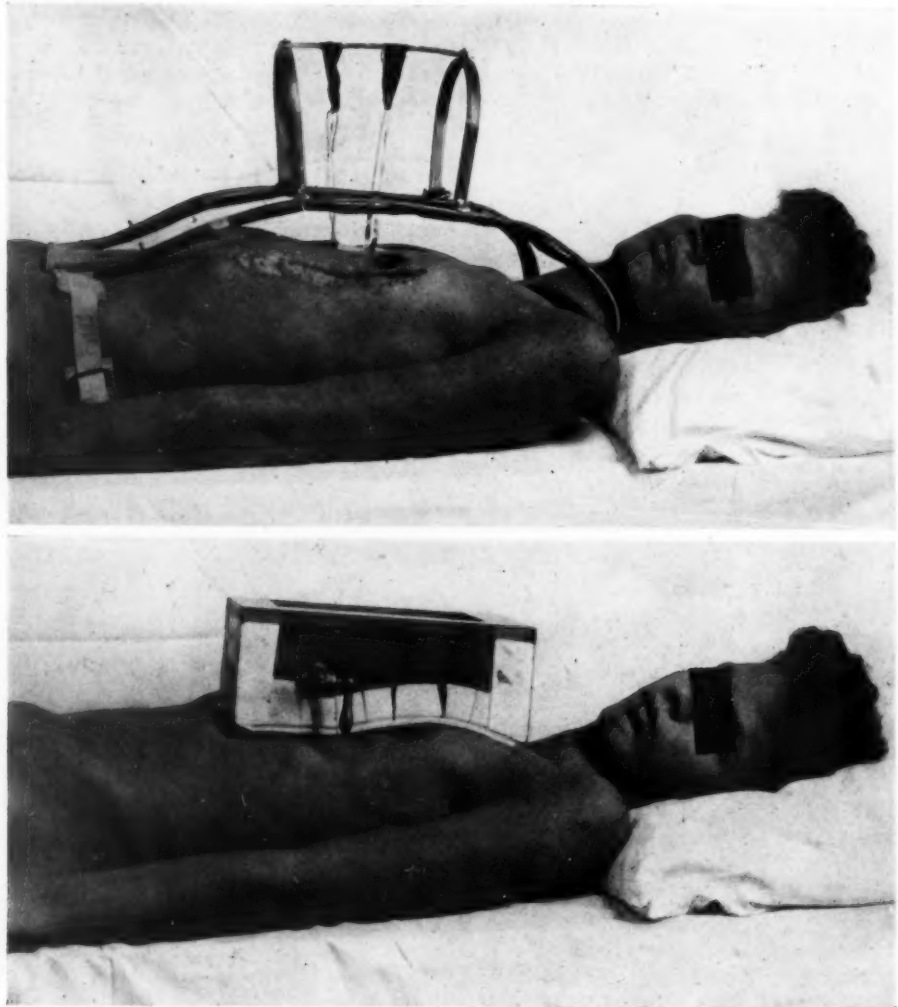


FIG. 6.—Case I. *Above:* Apparatus by which reduction of the sternal deformity was maintained for five weeks after operation. The band and wire surrounding the sternum are suspended to a bar by rubber bands. *Below:* Box that was air-tight with skin when negative pressure was created in it by connecting the pipe with the hospital air suction system. This box was used after removal of the apparatus pictured above in order to maintain reduction of the sternal deformity until firm bony union of the divided sternum and ribs occurred.

place of transverse division and then a finger, introduced behind the sternum through the epigastric incision, was easily able to lift forward the sternum and its attached cartilages so that reduction of the deformity was complete.

Throughout the operation care was taken not to separate the tissues of the anterior mediastinum from the sternum more than enough to admit the lifting finger. Wide

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separation would have resulted, temporarily at least, in a large dead space after the sternum had been lifted forward.

A Parham fracture band and a silver wire were made to surround the sternum transversely, passing, respectively, through the mesial ends of the fifth and sixth intercostal spaces. The band and the wire were then attached to heavy rubber bands which in turn were suspended from a bar which was carried by a special apparatus† that had been fitted to the patient before operation (Fig. 6). Rubber bands were valuable in providing a "cushion" between the patient's tissues on the one hand and the movements of respiration and of the patient within his brace, on the other hand. Adjustment was made so as slightly to overcorrect the funnel-breast deformity thereby allowing for a tendency toward recurrence of the deformity under the physiologic influence that was discussed in the second paragraph of this article. The skin incisions were closed without drainage. At this time the blood pressure was 112/76 and the pulse 90; when the operation was begun they were 128/60 and 84. During division of one of the cartilages the pleura was torn. The resulting traumatic pleural effusion disappeared after two aspirations.

Ten days after operation the elastic traction of the rubber bands caused the sternum below the site of its transverse division to bulge forward and the sternal cutaneous incision to break down. This was remedied by adjustment of the traction. Thirty-five days after operation the lassoing band and wire were removed because of considerable fever, which rapidly became normal and the patient was discharged. The pain for which the operation had been performed disappeared completely from the time of operation.

Three months after operation the patient was seen again and a tendency to recurrence of the deformity was noted. Blow bottles were prescribed and for three weeks he intermittently wore an ingenious suction apparatus that was designed by my associate Dr. W. W. Buckingham (Fig. 6). This maintained the sternum in nearly normal position until its bony fixation seemed assured. Temperature normal, average pulse 80, respirations 20.

Ten months after operation the patient wrote that he has no pain nor dyspnoea even on exertion and that correction of the deformity is maintained.

CASE II.—A woman of twenty was referred by Dr. George H. Schroeder, of Chicago, on January 20, 1930, to the Medical Department of the University of Michigan Hospital in the care of Dr. Cyrus Sturgis, with whom I saw her in consultation. She complained of severe pains in the region of the heart, palpitation and dyspnoea. Two years before admission she was in an automobile wreck when she is said to have fractured her left clavicle and pelvis and dislocated her hip. She had not been told that her sternum was fractured. She was confined to bed for fifteen weeks and then walked to the doctor's office for examination, climbed the stairs, had an attack of palpitation, dyspnoea and pain in the chest, and "collapsed." Since this time the symptoms have become more and more severe. The pain is aggravated into what she terms "attacks" by even a short walk, excitement or nervousness and in these attacks she is apprehensive. The pain which is usually in the region of the apex of the heart and left axilla, is occasionally referred to the left shoulder but not down the arm. Recently, she says, there has been some slight swelling of the legs and ankles. During the past three months she has been unable to work as housemaid.

She states that when six years old she was confined to bed for five weeks with painful joints from which she entirely recovered. Seven years ago she experienced attacks of dizziness, palpitation and fainting which her doctor said were due to cardiac disease. In common with her parents and three brothers and sisters, she is subject to attacks of migraine.

† This apparatus was designed and constructed by Mr. George E. Curry, Chief of the University Hospital Appliance Shop.

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Since the occasion when she "collapsed" in the doctor's office after the accident, she has presented many manifestations of hysteria, consisting in attacks of tonic and clonic convulsions of the extremities and eyelids; blurring of vision; inability to speak; blueness and coldness of the fingers and lips; severe constipation with great distension.

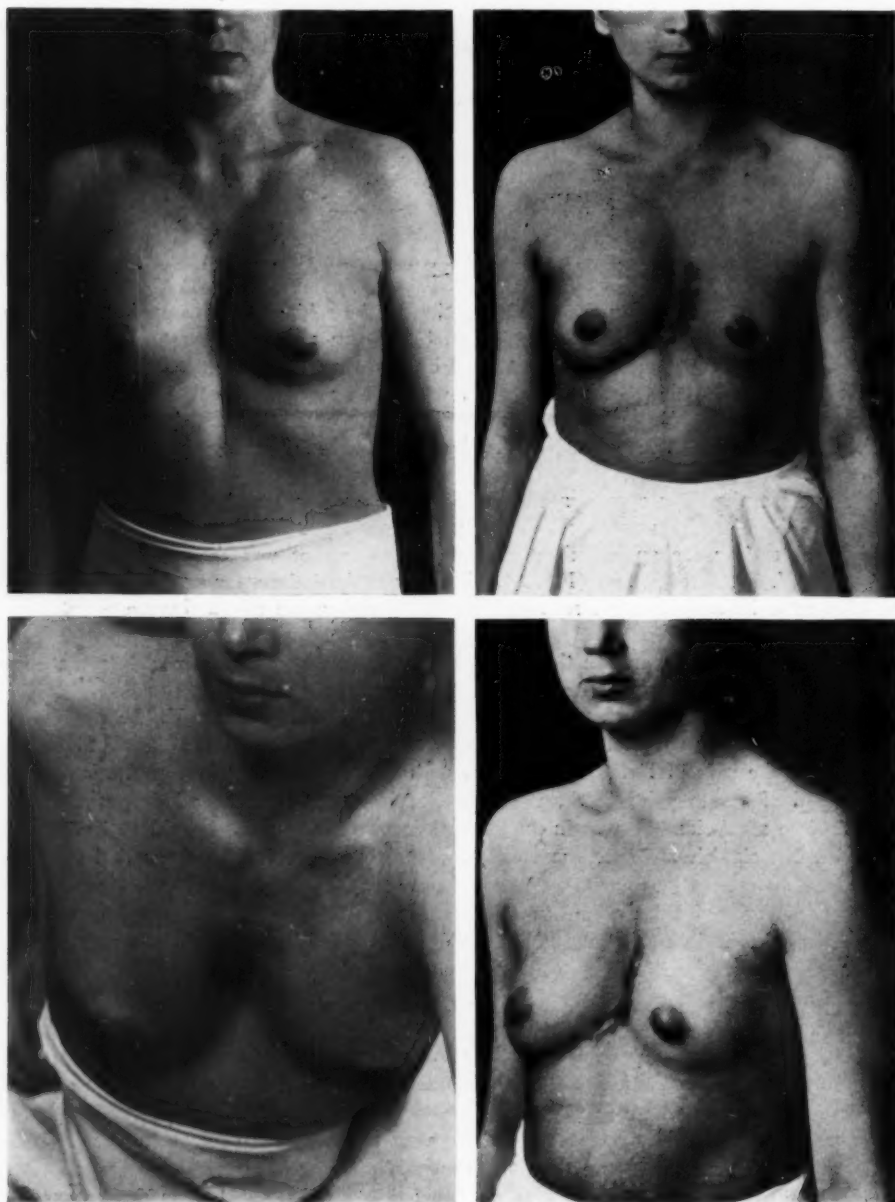


FIG. 7.—Case II. Before and after operation.

At various times during her residence in the hospital she has complained mildly of pains almost everywhere in the body, but severely only of those at the heart. She states that the convulsive attacks usually succeed a marked aggravation of cardiac pain. She does not bite her tongue nor urinate during them. In one attack observed at this



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hospital the cardiac rate was 200 and there were rapid deep sighing respirations and tight voluntary closure of the eyes. Dr. Carl Camp, Department of Neurology, confirmed the diagnosis of hysteria.

Examination showed a deep symmetrical depression (Fig. 7) involving the gladiolus of the sternum and the third, fourth, fifth and sixth costal cartilages. The maximum depth of the depression was at the level of the fourth intercostal space. The lateral röntgen film (Fig. 8) showed a sternal fracture at the level of the fourth cartilage, the upper fragment being drawn back about 5 centimetres. The antero-posterior film showed a bulging of the heart in the region of the left auricle. The size and position of the heart were approximately normal, the pulse from 80 to 100, blood pressure 125/80. At the apex and extending toward the axilla there was in the recumbent position a soft systolic murmur which increased during inspiration. In the first and second left intercostal spaces near the sternum there was a short high-pitched systolic murmur, which

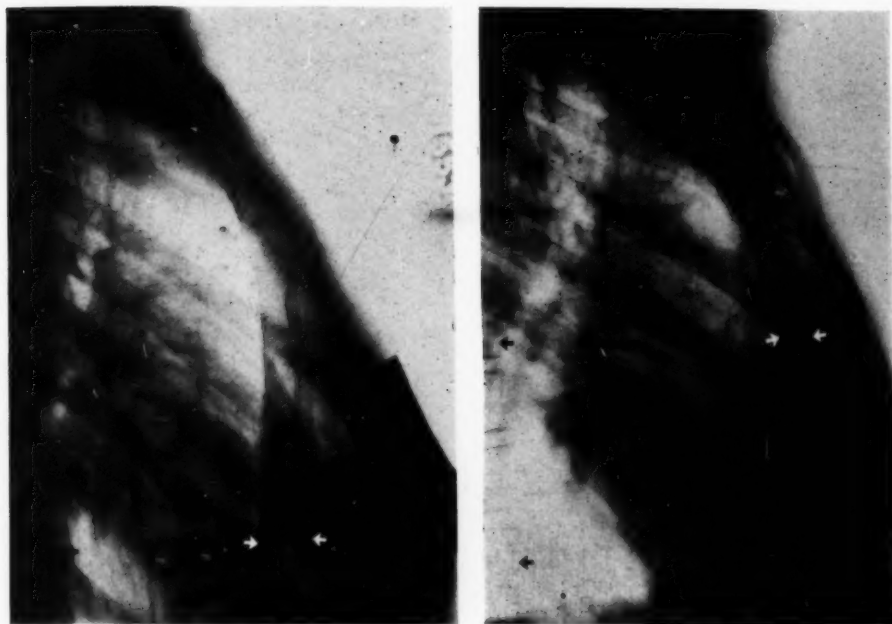


FIG. 8.—Case II. Lateral röntgenograms before and after operation. The white arrows indicate on the pre-operative print the sternum at the point of its greatest depression, and on the post-operative print the height to which the operative sternal resection was carried. The black arrows indicate the anterior surfaces of the vertebrae. (See Fig. 4.)

increased with inspiration, and a loud second sound. The murmurs were scarcely audible when the patient was sitting or leaning forward. There were no abnormal sounds in the tricuspid or aortic valve regions nor in the carotid or subclavian arteries. An electrocardiogram taken by Dr. Frank Wilson during one of her convulsive seizures, which began with marked increase in cardiac pain, showed only sinus arrhythmia and sinus tachycardia with an inverted T wave in lead 3 and flat in lead 2.

The feet and legs were cold. The lips, hands, feet and legs were slightly cyanotic but not oedematous. There were no abnormal pulmonary signs. The eye grounds were normal. No hyperaesthesia or paræsthesia but both conjunctivæ were anæsthetic. Physical examination otherwise was negative.

The patient was kept under observation and at rest by the Department of Internal Medicine for five weeks without noticeable improvement and after another five weeks at home the pain, if changed at all, was worse.

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Whether or not surgery was indicated presented a delicate problem. The patient certainly had hysteria and as certainly she had suffered a grave injury from an accident that had immediately killed her fiancé who was in the seat next to her. We had direct evidence of encroachment upon the heart by the depressed sternum, and the murmur in the pulmonic valve area suggested the possibility of some depression of the anterior wall of the right ventricle. The cardiac pain was disabling and unrelieved by prolonged rest. The patient consented to operation (Fig. 9) which I performed on April 4, 1930, under nitrous oxide anaesthesia.

A gently curving incision was made from the left second intercostal space at the parasternal line to the sixth left cartilage and then across to the right border of the sternum. The fourth and fifth left costal cartilages were removed extraperiosteally and the fourth intercostal bundle and transversus sterni muscle divided and the pleura pushed

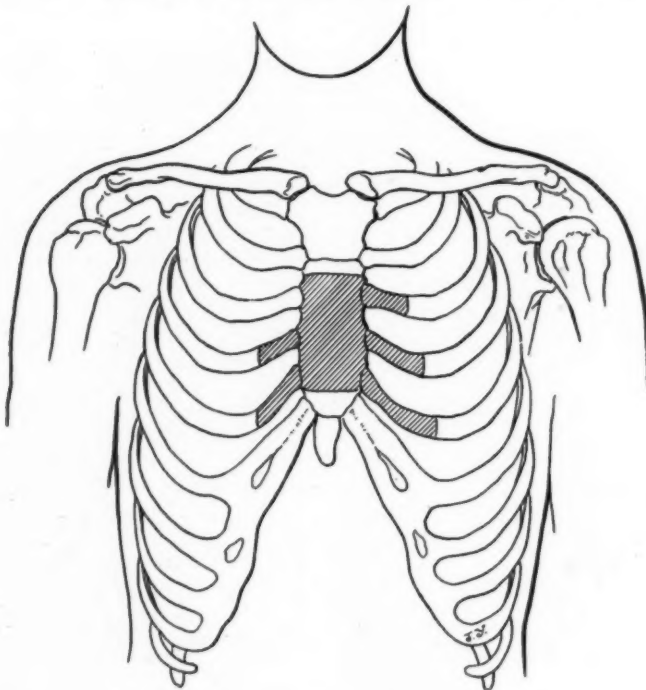


FIG. 9.—Case II. Shaded area indicates portions of sternum and cartilages removed at operation.

to the left. A finger introduced between the depressed sternum and the heart was tightly squeezed; after removing with the rongeurs the left half of the sternum between the second and sixth cartilages, the heart definitely bulged forward and the anaesthetist noted a marked improvement in the volume of the pulse. Then the entire width of the sternum with almost all of its periosteum was removed between the level of the sixth costal cartilages and just below the level of the second cartilages. The third left cartilage was now removed, as had been the fourth and fifth, to within 2 centimetres of their costo-chondral junctions and the mesial 2 centimetres of the fourth and fifth right cartilages were also removed (Fig. 10). The right pleura was torn and the lung was kept expanded by slightly raising the pressure of the anaesthetic gas being fed to the patient. The resulting skeletal defect measured 9 by 6 centimetres. The mesial edges of the pectoralis major muscles, which had been lifted on each side in order to resect cartilages, were sewn together without tension. The subcutaneous tissue, which was unusually thick, and the skin were sutured as separate layers.

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These continuous strong sheets of pectoral muscle (after operation, contraction of the pectoral muscles showed that they spanned the bony defect as a continuous sheet) and subcutaneous tissue, together with what bone might form from the fragments of periosteum that were not removed, seemed to promise adequate protection to the heart and against herniation of the heart and pulmonary borders. Such herniation is sometimes seen in congenital absence or cleft of the sternum (Greig<sup>9</sup>) but in these cases there is absence of the pectoral muscles in front of the defect, and only skin covers the pericardium. Should herniation have occurred in my patient I would have placed a grill of costal or cartilaginous strip grafts in the defect.

At the beginning of the operation the pulse was 116 and the blood pressure 125/85; at the end they were 92 and 108/80.

From the time of operation the cardiac, axillary and left shoulder pain was no

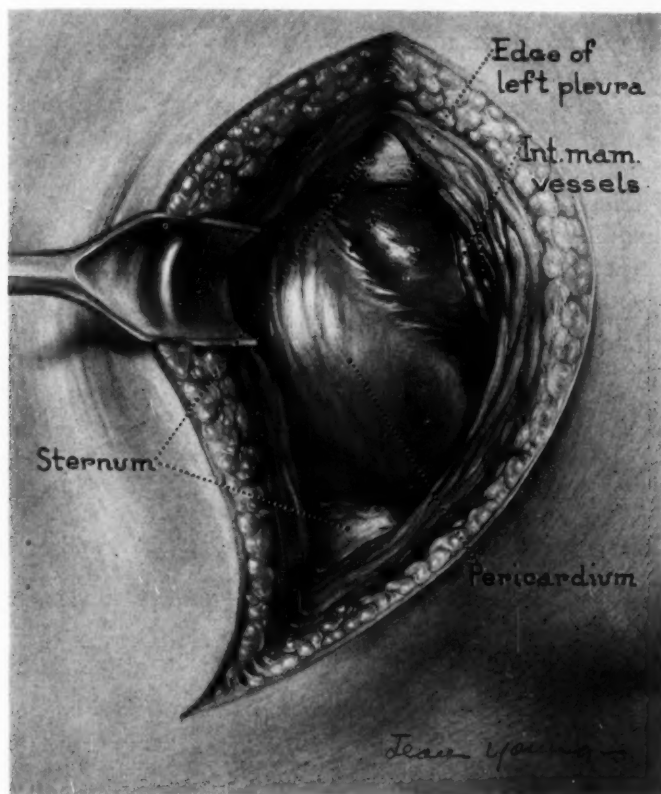


FIG. 10.—Case II. Structures exposed after removal of the portions of sternum and cartilages that are pictured in Fig. 9. The heart is bulging forward a little after its decompression.

more. After her operative convalescence she was accepted by the Department of Neurology for treatment of her continuing hysterical manifestations.

Before operation there was a respiratory expansion of 2.5 centimetres in the sagittal diameter of the thorax at the level of the greatest depth of the depression and after operation of 6 centimetres. After operation the antero-mesial ends of the cartilaginous stumps moved somewhat posteriorly during inspiration while the ribs at the mid-clavicular lines moved anteriorly.

At the time when these operations were performed I knew of no precedent and therefore devised technics which seemed suited to the individual

problems. In the first patient the defect was considerably broader than in the second and the resection type of operation might have entailed removal of greater lengths of the cartilages than would have been safe with respect to protection of the thoracic viscera. This factor was of slight additional importance because the patient was a male who might be expected to lead a more strenuous life than a woman, and who had no prominent breasts to serve as a buffer against trauma.

Operation in the first patient was certainly a far more extensive one than in the second, but it did not prove to be shocking and it did leave complete bony protection to the thoracic viscera. The second operation was far simpler to perform and its effective action did not depend upon a complicated and difficult maintenance of reduction of the deformity until firm bony union should have taken place. Also it was possible, although at operation the supposition was found to be false, that the frank fracture of the sternum, with its resulting callus, that had occurred in the second patient might have presented technical obstacles to the "unfolding" operation that was performed in the first patient. The loss of the bony covering of the heart seems to be of little consequence in the second patient for the reasons that I have given.

In neither case did the operation cause any detectable impairment of cardiac or respiratory function and in both the purposes for which operation was performed were fulfilled.

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## ACTINOMYCOSIS OF THE KIDNEY \*

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RENAL actinomycosis in the past has been considered as primary when the disease was confined to the kidney, and secondary when other actinomycotic lesions were associated in other structures of the body. It is difficult to conceive of the kidney as the site of a primary infection, and it would seem that involvement of the kidney, in most instances, if not in all, must be secondary to a portal of entry through mucous membrane. The kidney may become involved by direct extension from the gastro-intestinal tract in abdominal actinomycosis, through the diaphragm from pulmonary disease, or by metastasis through the lymphatics or blood-stream.

In the case herein reported, as nearly as can be determined, the disease was confined entirely to the right kidney, as is evidenced by the patient's complete recovery after right nephrectomy. However, that the condition may have been secondary to actinomycosis of the appendix must be given consideration, even though such infection was never proved in the appendix or intestinal tract, and even though there was no evidence that such infection ever had existed.

REPORT OF CASE.—A man, aged thirty-two years, an accountant, previous to July, 1928, had had repeated attacks of pain in the right lower quadrant of the abdomen. In July, 1928, he was operated on elsewhere than at the clinic, and a ruptured, partially gangrenous appendix was removed. Drains were inserted for three weeks; then the wound was allowed to heal. In six weeks, apparently after an uneventful recovery, he left the hospital with only a slight amount of serous drainage. This subsided and he gained in strength.

September 10, 1928, what was apparently a stitch abscess developed and was drained. The wound was packed for one week and finally healed. September 27, the patient felt feverish, had night sweats, lost appetite and pain developed in the right costovertebral angle. Examination revealed only a tender right kidney. The patient was hospitalized, symptoms continued, and vague distress developed in the right portion of the epigastrium. The urinary tract was normal on laboratory and cystoscopic examination. The condition grew worse. A mass, which seemed to be liver, became palpable and progressed downward; it was painful to pressure and movement. Chills, jaundice, or digestive disturbances other than a poor appetite were not present. There was less pain over the costovertebral space; the urine was clear; leucocytes numbered 16,000 in each cubic millimetre of blood. October 27 it was concluded that a retroperitoneal abscess was present. A small incision was made in the right upper quadrant of the abdomen, and after careful exploration only slight enlargement of the liver was found. The incision was closed without drainage and primary healing occurred.

February 25, 1929, a cold developed; the patient had a chill and ran an elevated temperature for ten days. He had another chill, following which he improved except for residual discomfort in the right kidney. April 4 the symptoms and signs of October,

\* Read before the American Association of Genito-Urinary Surgeons, May 22, 1930.

1928, were exactly reproduced except that this time the amount of pus in the urine was increased.

May 16, 1929, the patient registered at The Mayo Clinic. He weighed 115 pounds, which, according to him, represented a loss of twenty-five pounds. His skin was tanned but he was anæmic, graded 2, and his tongue was furred. He had moderate tenderness in the right costovertebral angle, and resistance in the right upper half of the abdomen.

In the hospital he ran a septic temperature varying between 102.5° and 97.3° F. In röntgenograms there was a large right renal shadow and absence of the outline of the psoas muscle. The urine repeatedly contained pus, graded 3. Leucocytes numbered 13,000 in each cubic millimetre of blood. The concentration of hæmoglobin was 30 per cent. In a test of renal function with phenolsulphonephthalein 80 per cent. of the dye was returned. The Wassermann reaction of the blood was negative. The concentration of



FIG. 1.—Elongation of upper and lower calices, suggesting tumor.

urea was eighteen milligrams in each 100 cubic centimetres of blood. A right pyelogram, May 20, showed that the pelvis was small, and that there were several small filling defects. The upper and lower calices were elongated and the middle calices were absent. The upper minor calix was dilated. The ureter was normal. The pyelogram suggested a right renal tumor, with marked decrease in function and marked infection of the kidney. (Fig. 1.) The left kidney was normal in function.

May 24, right nephrectomy was done. The kidney was one and a half times normal size and was densely adherent as a result of old perinephritic abscess, which, although large, had pretty well subsided. What appeared to be a carbuncle measured eight, six and four centimetres in various diameters and involved the middle third of the renal substance. The pathologic report was of multiple confluent abscesses involving the cortex and medulla of the central portion of the kidney; so-called carbuncle of the kidney; marked perinephritis, with old perinephritic abscess, and destruction of about 70 per cent. of the renal substance. (Figs. 2 and 3.)

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July 3, nearly six weeks after operation, a diagnosis of actinomycosis was made through recovery of actinomyces from the wound. The wound, at this time, consisted of multiple deep sinuses, and in order to carry out adequate therapeutic measures for actinomycosis, the wound was widely opened to the bottom of all sinuses and was packed wide open with gauze. Intensive treatment with röntgen-rays and with the use of radium in the depths of the wound was instituted. Iodides were given in the form of a 10 per cent. solution of sodium iodide intravenously, and potassium iodide by mouth. The patient was dismissed December 2, 1929, with a practically completely healed wound and with return of normal weight and strength. It has not been possible, at any time, to find lesions elsewhere in the body which might be considered to be those of actinomycosis. Repeated röntgenologic examination of the thorax failed to reveal any evidence of pulmonary involvement.

Within two weeks we have had a report on the patient's condition. Complete healing of the wound has occurred, and the patient is entirely well.

*Comment.*—If the original classification of actinomycosis of the kidney must be adhered to, this case may well be considered one of primary acti-



FIG. 2.—External surface of kidney.



FIG. 3.—Extensive involvement of kidney.

nomycosis with recovery subsequent to nephrectomy. Israel was the first to report a case of primary renal actinomycosis. At the time the report was made, in 1901, the patient had remained well eleven years after nephrectomy. The same author in 1911 reported a second case, with recovery after nephrectomy. Since that time Stanton, Kunith, Kleinschmidt, Pinner, Bevan, Abbot, Peacock, Christison and Warwick, and Beregoff have each added one case. Von Lichtenberg stated in his "Handbuch der Urologie" that primary renal actinomycosis had been reported only seven times; Von Lichtenberg included, as did Abbot, a case reported by Theodore Cohn and one by Earl. Data available did not seem sufficient for us to include Cohn's case as one of true renal actinomycosis. Data in Earl's case are lacking beyond the statement that the patient was a male, aged fifty-two years, in whom a secondary actinomycotic abscess of the brain was found.

The case reported by Christison and Warwick can hardly be considered one of renal actinomycosis, for only the suprarenal gland was involved and that secondarily to pulmonary actinomycosis in which the infection had traversed the diaphragm.

The kidney is sometimes involved secondarily as a part of generalized actinomycosis. Von Lichtenberg stated that secondary actinomycosis of the kidney occurred in nine of 128 fatal cases of actinomycosis in which necropsy had been done, an incidence of 7 per cent. In all but one of these nine cases both kidneys were involved. Pinner stated that in 460 cases of actinomycosis of the thorax and abdomen there were sixteen in which the kidney was involved secondarily.

Objective and subjective data concerning the urinary tract and suggesting renal tumor or infection of the kidney in the presence of actinomycosis else-

TABULATION  
*Summary of cases of renal actinomycosis from literature*

Author	Age, years	Sex	Pre-operative diagnosis or basis for diagnosis	Operation or necropsy	Observations at necropsy	Results
*Israel	33	M	Actinomyces from sinus	Nephrectomy		Recovery
*Israel	60	F	Perinephritis	Nephrectomy		Recovery
*Stanton	53	M	?	Necropsy	Actinomycosis confined to right kidney	Death
*Kunith	5	M	?	Nephrectomy		Recovery
Kleinschmidt	24	M	Renal tumor	Nephrectomy		Unknown
*Pinner	40	M	Actinomyces found in urine	Nephrectomy		Recovery
Bevan	?	M	?	Drainage		Unknown
Abbot	43	F	Renal tumor	Drainage	Perinephritic abscess; destruction of two vertebrae; multiple actinomycosis of lungs	Death in two months
Peacock	8	M	Renal tuberculosis	Nephrectomy	Actinomycosis of liver	Death
Christison and Warwick	8	M	?	Necropsy	Extensive actinomycosis of lungs and involvement of right suprarenal gland	Death
Beregoff	63	F	Actinomyces found in urine	Necropsy	Bilateral renal actinomycosis	Death
*Hunt	32	M	Renal tumor	Nephrectomy		Recovery

\* Apparently true cases of primary renal actinomycosis.

where, or history of preëxisting actinomycosis perhaps should cause one to think of this type of renal involvement. However, unless actinomyces are present in the urine or in a post-operative sinus, there is little to suggest a pre-operative diagnosis of renal actinomycosis. In the cases reported in the literature it is of interest that actinomyces were found in the urine of two patients (Pinner's and Beregoff's) and this led to the clinical diagnosis of renal actinomycosis. In several instances, the diagnosis was established through the finding of actinomyces in material from a sinus which persisted after drainage of a perinephritic abscess or which persisted subsequent to nephrectomy. In three cases, including our case, a pre-operative diagnosis of renal tumor had been made.

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In seven of the twelve cases in the literature, including our case, nephrectomy was done. Five patients recovered. The result in Kleinschmidt's case, in which nephrectomy was done, is not recorded. Death occurred on the twelfth day in Peacock's case in which nephrectomy had been done, and actinomycosis of the liver was found at necropsy.

The prognosis in actinomycosis in general is notoriously poor. Recovery from so-called primary renal actinomycosis, when the disease is confined to one kidney, may be expected only by means of nephrectomy and the institution of therapeutic measures such as those which are employed for actinomycosis in other situations. These measures were used in the case reported and are, in brief, the following: (1) maintaining the wound wide open to its most dependent parts; (2) packing the wound wide open, down to its lowest depth, with gauze saturated with dichloramine-T in 4 per cent. solution, or with compound solution of iodine (Lugol's solution) diluted to one-third to one-half strength; (3) introducing radium into the wound as long as sulphur bodies are repeatedly found; (4) administering treatment by röntgen-rays over the entire area, and (5) persisting in the use of iodides in the form of a 10 per cent. solution of sodium iodide intravenously, or the oral administration of potassium iodide, or both.

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## ENUCLEABLE MULTILOCULAR ABSCESS (CARBUNCLE) OF THE KIDNEY\*

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Two cases have, in large measure, furnished the basis for the above title. Their records will be used as an introduction to a brief discussion of the treatment of a relatively uncommon renal condition.

CASE I.—A man, twenty-four years of age, admitted to the Surgical Service of the University of Virginia Hospital, May 19, 1923, had had diffuse abdominal pain, malaise and fever for six days. Significant physical findings were lacking. During three days' observation, his temperature ranged between 103° and 106°, pulse around 90, leucocytes were 6000, urine showed a few pus-cells. He was then transferred to the Medical Service with a tentative diagnosis of typhoid fever.

There, repeated blood cultures, stool cultures and serological tests did not reveal a typhoid or paratyphoid infection. He slowly developed localized discomfort and tenderness in the right flank, ultimately presenting, just below the rib margin, a rounded mass moving with respiration. Coincidentally, the temperature chart exhibited a septic curve, the leucocyte count mounted to 17,000. June 25 he was transferred to the Urological Service.

Both kidney urines were pus-free, cultures negative. Thirty-minute phthalein output after intravenous injection was 16 per cent. on the right, 12 per cent. on the left, no bladder leakage. Right pyelogram was normal but the renal shadow was abnormally large. A working diagnosis was made of renal abscess or perinephritic abscess, or both. At operation, June 27, the posterior perirenal tissues were soft, the kidney itself about twice normal size, intensely congested. As it was being freed intracapsularly, pus pockets were entered in a prominent area on the anterior surface of the middle third. By mere chance, my finger found a line of cleavage about a localized suppurative mass and readily enucleated it. The resulting depression had a diameter of about five centimetres, and a depth of two centimetres. Its wall was smooth and appeared healthy. Save for the marked congestion, the remainder of the kidney seemed normal. A two-ounce perinephritic abscess medial to the kidney had evidently followed erosion of the capsule overlying the conglomerate renal abscess. Thorough drainage was established and the wound loosely closed. *Staphylococcus aureus* was grown from the pus. (A later account was secured of a few boils antedating onset of illness by a month.)

*Pathological report.*—Dr. W. E. Bray. "Specimen is an irregular mass 6 by 4 by 2 centimetres, rather firm, containing many small gray abscesses and a few large ones. Microscopic sections show kidney tissue with degenerated tubular epithelium. The tubules are separated by rather large amounts of young fibrous tissue in which are many deeply staining round cells and plasma cells, as well as p. m. n. s. Here and there are miliary and larger abscesses with areas of necrosis. Some abscesses have considerable fibrous tissue in their walls. There is some necrosis near the edge of one section, but this does not suggest an infarct. *Diagnosis.*—Acute purulent inflammation with abscesses; chronic inflammation."

The patient was discharged well thirty-seven days after operation.

CASE II.—A man, twenty-nine years of age, admitted August 27, 1924, had suffered from recurrent, severe, left renal colic for seventeen days, afebrile for the first twelve days,

\* Read before the American Association of Genito-Urinary Surgeons, May 22, 1930.

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thereafter with chills and fever. I first saw him September 1. Temperature then was 104°, leucocytes 13,000, the urine pus-laden. There was slight tenderness in the left flank, no induration. He presented an extensive Vincent's gingivitis, a sternal periostitis, an effusion in the left knee, a positive blood culture (*staphylococcus aureus*). Urinary tract films were negative. Cystoscopic investigation had shown the left urine very purulent, the right clear, the left fifteen-minute phthalein output 0, the right 8 per cent. Ureteral catheter drainage of the left pelvis had been established.

The sternal infection went on to a frank *staphylococcus osteomyelitis*, resulting ultimately in the loss of two-thirds of this bone. The gingivitis was controlled after three weeks of vigorous treatment. Blood cultures were positive through September 6.

Cystoscopic findings September 19 were as before, both kidney cultures positive (*staphylococcus aureus*). There was slight pain and tenderness in the left flank, no induration.

A small stone was found in the bladder September 29. This had no doubt come from the left ureter though neither X-ray examination nor repeated ureteral catheterization had suggested its presence. The left urine still contained much pus, but phthalein output (fifteen-minute intravenous) had risen to 6 per cent. against 11 per cent. on the right. Save for slight fuzziness of outline, the left pyelogram appeared normal.

October 4 abscesses of the prostate and soft tissues over the left shoulder were drained. By October 10 there was induration both in the left costo-vertebral angle and deep-seated in front below the kidney region. Temperature continued to have a daily maximum of 102° to 103°. The kidney was explored that date with a working diagnosis of pyelonephritis and perinephritic abscess. The perinephritic tissues were very thick and œdematous. About five ounces of pus were evacuated from an abscess below the lower pole. The true renal capsule was exposed, opened and gently separated from the kidney. On the anterior surface of the upper one-third a group of abscesses was thus demonstrated. Since the feel and appearance here called to mind the previous case, a line of cleavage was sought and found. A septic mass approximately five to six centimetres in diameter was readily enucleated. It had a clean-cut line of demarcation from the surrounding kidney and seemed to have a very definite capsule. While the kidney was large and very hyperæmic, neither palpation nor inspection gave evidence of other abscesses. The kidney, therefore, was not removed.

*Pathological report.*—Dr. W. E. Bray: "Carbuncle-like mass measuring about 5½ by 3½ by 3½ centimetres, surrounded, save where ruptured, by a thin glistening capsule. Cross-section shows discrete abscesses of varying size, all containing thick greenish-yellow pus. Microscopic sections show acute suppurative inflammation of the kidney with multiple abscesses. One edge of the section is smooth and covered chiefly with fibrin and blood, along with some purulent exudate. No definite old fibrous capsule is made out, but there is an incomplete peripheral layer of young granulation tissue (early stage of encapsulation)."

His general condition promptly improved markedly. The daily temperature maximum shortly dropped to 100°. Seventeen days after operation the left kidney urine was grossly clear, sediment showed six to eight pus-cells to the high power field, culture was still positive. Phthalein output was 11 per cent. on the right, 6 per cent. on the left. Three days later, October 30, his temperature suddenly jumped to 104° and remained at that level. Careful overhauling revealed no new development to account for the change. It was decided that further suppuration in the left kidney was the most probable cause. For this reason, a nephrectomy was done November 3. "The kidney measured 15 by 6 centimetres. The surface is smooth except near the upper and middle thirds where there is a depression at the site of the former operation. The kidney is firm and the cut surface is apparently normal except for a few small yellowish opaque areas suggesting fatty degeneration. *Microscopic.*—One section shows almost complete loss of normal structure, being chiefly inflammatory tissue with œdema, hæmorrhage, and cellular infiltration. Another section shows dilated tubules with degenerated and desquamated epithelium and a number of hyalin casts, also purulent exudate in a few tubules. The

section through base of operative depression shows hæmorrhage, œdema and infiltration with round cell, p. m. n. s. and a few giant cells. There is considerable young fibrous tissue superficially and hyalinization of deeper fibrous tissue. Shortly after the nephrectomy a right pneumonia was demonstrated, this followed by a streptococcus empyema. Death occurred November 8. An autopsy was not permitted.

The localized inflammatory process above described obviously warrants the title multilocular abscess and, further I think, fulfills all the requirements of the lesion first called renal carbuncle by Israel in 1891. Objection is raised from time to time to applying the term carbuncle to the kidney on the ground of definitional incompatibility or of adding further complexity to the classification of renal infections. While there is sound logic in this, the vivid descriptive value of the word, together with the sanction of increasing international usage, has doubtless secured for it a permanent place in medical terminology. It must be remembered, however, that the renal carbuncle of many writers is the infarct, septic infarct, multiple abscess, conglomerate abscess, or abscess of others.

The carbuncle in Israel's first patient was so sharply defined in color and consistency from the surrounding uninvolved kidney tissue as to give the impression of an imbedded tumor. Subsequent writers have often emphasized similar striking demarcation by verbal description and sometimes by accompanying illustrations. (Horn, Reschke, Barth, Nicholich, Hotchkiss.) In Fisher's case the carbuncle was actually sequestered. Barth and Smirnow in particular refer to the rich increase of connective tissue found about the pus pockets. An occasional illustration (Dick) suggests a thick fibrous tissue layer encircling the whole mass.

Other authors speak of the carbuncle shading off imperceptibly into the adjacent renal tissue. Frequently the carbuncle bulges above the cortical surface and has developed more at the expense of the cortex than the medulla. It may, however, be quite deep-seated and of an extent to cause demonstrable compression of a calyx or calices, even of the pelvic body. Infrequently there may be two lesions in the same kidney (Smirnow, Eisendrath).

The carbuncle now and then is reported as having broken down to practically a single abscess cavity. It has not always been clear to me how cases found in the abscess stage and cured by drainage have justified report as carbuncles. Smirnow concludes that renal carbuncle has no tendency to such breaking down and will not accept as carbuncles large solitary abscesses so reported. I would deem it perfectly possible for a renal carbuncle to soften down to a solitary abscess but, so found, the evolution is hard to prove.

In a series of fifty-seven cases collected from the literature, the following final methods of treatment have been employed: primary nephrectomy twenty-eight times with two deaths; incision and drainage eleven times with two deaths; secondary nephrectomy eight times with one death; primary excision six times with no deaths; secondary excision twice with no deaths; and enucleation twice with no deaths. The nephrectomies totaled thirty-six with three deaths; other operations twenty-one with two deaths.

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The figures indicate the decided necessity of, or preference for, nephrectomy as the surest and safest form of treatment. The extent of the process in many of the cases so handled clearly would have made a less radical procedure foolhardy. The illness of the patient sometimes has led to removal of the kidney even though the carbuncle seemed resectible (Barth). One would certainly expect nephrectomy to secure the smoothest convalescence, particularly if there is no complicating perinephritic abscess. Even the strongest advocates of primary conservative operations state that a later nephrectomy may be required.

Israel considers resection to be peculiarly suitable and feasible for renal carbuncle. He mentions the potential danger of thus leaving unrecognized foci but believes such may well be taken care of by the body once the chief suppurative lesion is removed. Reschke successfully utilized excision three times and is a forceful advocate of conservative surgery for the condition. One of his excision cases developed an abscess in the same kidney during convalescence but this was readily drained through the original wound. Barth employed excision once with a good result and expresses the belief that he could readily have done so again in place of a nephrectomy. Nicholich voices a similar feeling in discussing the sharp demarcation of the carbuncle in a removed kidney. Successful resections are recorded by Lennander, Blum (cited by Israel), von Herczel (cited by Voss). Most writers mention resection as a possibility where the carbuncle is small, early, or sharply delimited, but actually the method seems to have been used quite infrequently. Where employed, incisions have been carried into the surrounding healthy tissue and the carbuncle extirpated in one or more pieces.

The only cases I found handled by enucleation are two reported as having infarcts by Hotchkiss in 1913. In the first, in addition to a perirenal abscess and an abscess of the upper pole, "there was found also a considerable triangular area of soft, white infarction, apparently riddled with small abscesses, and measuring about two inches across its base and not extending into the pelvis . . . infarcted portion readily enucleable with finger . . . was neatly extirpated in this manner . . . the walls of the triangular gap in the kidney looked to be covered with granulations." Recovery followed. His second case showed a small perinephritic abscess. "There was a good-sized white infarct in the upper pole of the organ, which was riddled with small abscesses. As the rest of the organ appeared uninvolved, the whole area including the infarct was easily enucleated with the finger and without any considerable bleeding as the wall of the gap in the kidney appeared to be granulating, and healthy."

The enucleation in my first case was entirely unpremeditated and followed upon my finger finding an unexpected line of cleavage as the extent of the carbuncle was being explored. In both cases the enucleation was as easy as is the shelling out of a fibromyoma from the uterus. The second specimen grossly had a very definite glistening white capsule. Such was not observed for the first case, though the demarcation from the surrounding renal tissues was equally sharp in both instances.

I am convinced that the secondary nephrectomy in Case II was quite unnecessary. The gross and microscopical appearance of the kidney suggested that it was recovering well from the unusual combination of an obstructive pyelonephritis and a carbuncle. The wisdom of having done



a nephrectomy shortly after admission is another question but not pertinent to the topic under discussion.

Conservative surgery for renal carbuncle gains considerable support from an analysis of the twenty-one cases so treated—removal ten, incision and drainage eleven—in the series of fifty-seven reviewed. No secondary nephrectomies were necessary. Autopsies on the two patients who died, four days and twenty-four hours, respectively, after drainage of a carbuncle, revealed thrombosis of the iliacs and vena cava in one and an unsuspected carbuncle in the second kidney in the other.

The rare occurrence of bilateral involvement must be kept in mind in deciding upon the operative involvement for a given patient. Kretschmer has reported one such case, Smirnow cites two (Stuckey, Rjasanzewa). Reschke recounts the autopsy demonstration of a carbuncle in one kidney and an abscess in the other. The problem for the surgeon is much simpler, confronted later with a suppurative lesion in the second kidney, if the original carbuncle has permitted handling by some method less radical than nephrectomy.

I have no means of estimating how often enucleation will be possible for renal carbuncle. I feel it will occasionally prove a practical method where an excision, or, more particularly, a nephrectomy might otherwise be done. The paucity of reference to the procedure in the literature has seemed to justify giving it some attention. Certainly, when feasible, it is ideally conservative.

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## INDICATIONS AND TECHNIC OF COMBINED URETERONEPHRECTOMY\*

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A REVIEW of the progress made in reno-ureteral surgery since the first nephrectomy was performed by Simon in 1868 reveals that very little attention has been given to the variety of pathological lesions that involve the surgical ureter and necessitate its complete removal.

The intention of this presentation is, therefore, to focus the attention, particularly of specialist surgeons, upon the various problems that oftentimes arise after nephrectomy, when an infected ureter stump has been left behind. It is also my purpose to point out the convenience and the importance, whenever there is a definite lesion of the ureter that requires such a radical procedure, of the two-stage aseptic operation for the excision of the entire ureter and kidney in one piece and at one sitting; namely, a total ureteronephrectomy, as in the case of a young patient on whom I performed it, a few months ago, with a curative and successful result.

It must be remembered, however, that most authors have always accepted the idea that the remaining portion of the iliopelvic ureter ligated at the lower pole of the kidney and left behind after a lumbar nephrectomy becomes functionless and atrophic and is gradually reduced to a fibrous thin cord of aberrant tissue without further significance as a potential site or cause of further trouble.

Moreover, studies upon the normal ureter after nephrectomy, both by animal experimentation and clinical observation, have led to the conclusion that the ureter loses its rhythmic contractions and becomes obliterated in a period of from nine months to three years, by gradual and marked atrophy of its muscular coat. Although this assertion must be granted as regards the evolution of the normal ureter, the case is otherwise with abnormal infected ureters which present hazards. It seems right to emphasize that when the pathological condition involving the kidney has invaded the walls of the ureters, and caused marked ureteritis with nodular infiltration and peri-ureteritis or hypertrophic hydro-ureter or pyro-ureter, if this is not removed in its entire length at the time of nephrectomy, surprising trouble is liable to arise from the infected stump of the ureter. This occurs more times than the urologist cares to remember, as I have found in a survey of the literature, and has been in many instances, and in fact in my own practice, the cause of persistent urinary disturbances, which after long suffering and the use of various methods of treatment fail to obtain cure and ultimately

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necessitate a subsequent ureterectomy. In other words, the usual complications of what should have been a curative nephrectomy are manifested clinically by a long delay in the healing of the wound, with persisting uropurulent lumbar fistula, marked pyuria, hæmaturia, tumor and stone formation, with colic pain in the abdomino-inguinal region, bladder tenesmus and frequent desire to urinate—symptoms which obviously call for excision of the infected stump ureter by a secondary operative procedure that is difficult to perform owing to the condition of septic ureter and the formation of scar tissue and dense adhesions to the walls of the peritoneum and surrounding structures of the lower pelvis.

Not until recent years with the development of pyelography, ureterography and cystography has it perhaps ever been possible to recognize the clinical and anatomopathological entity with perfect accuracy in the diagnosis, before performing a surgical intervention upon this duct, whose main function is none other than that of conveying the urine from the kidney to the bladder. The routine method of urological examination nowadays is so essential that no operation upon the organs of the upper urinary tract can be practically justified without the assurance of a sound prognosis such as can be obtained only by the brilliant methods which are now available in modern urography.

Several conservative operations are performed upon the ureters, but at the present time I will discuss only the indications and technic of a total ureteronephrectomy obviating the necessity of a secondary ureterectomy in the attempt to relieve symptoms and to produce a permanent cure. I shall, therefore, briefly review the literature on the subject and the different methods of technic employed, and will finally attempt to illustrate my paper with the report of two personal cases which I was so fortunate as to handle with success and which have been the basis of this study.

These two cases represent the two most common types of surgical problems to be encountered in routine practice. The first is a case of nephrectomy for atrophic, hollow kidney, without function, secondary to multiple stone long impacted in the pelvic ureter, which necessitated, four months later, a subsequent ureterectomy for the infected stump of the ureter, in order to cure a permanent lumbo-abdominal fistula. The second illustrative case, in a girl seventeen years old, with a long history of disturbances in which the pyelo-ureterogram revealed a megalo-ureter or hydropyo-ureteronephrosis with complete loss of function, is one in which I did a two-stage aseptic ureteronephrectomy in one sitting, ending with an uneventful recovery. The operation, while appearing to be a formidable one, is, in reality, quite safe and does not affect the patient more than any other simple surgical procedure.

#### HISTORY AND LITERATURE

Operations upon the urinary tract, particularly for the removal of stone or to drain pus cavities, are known to have been performed since the time of



FIG. 1.—Case I. Röntgenogram with catheter and instrument in position, showing shadow of multiple urinary calculi impacted in the sacroiliac pelvic portion of the left ureter of long standing, causing obstruction to normal drainage and making the catheterization of the ureter impossible.

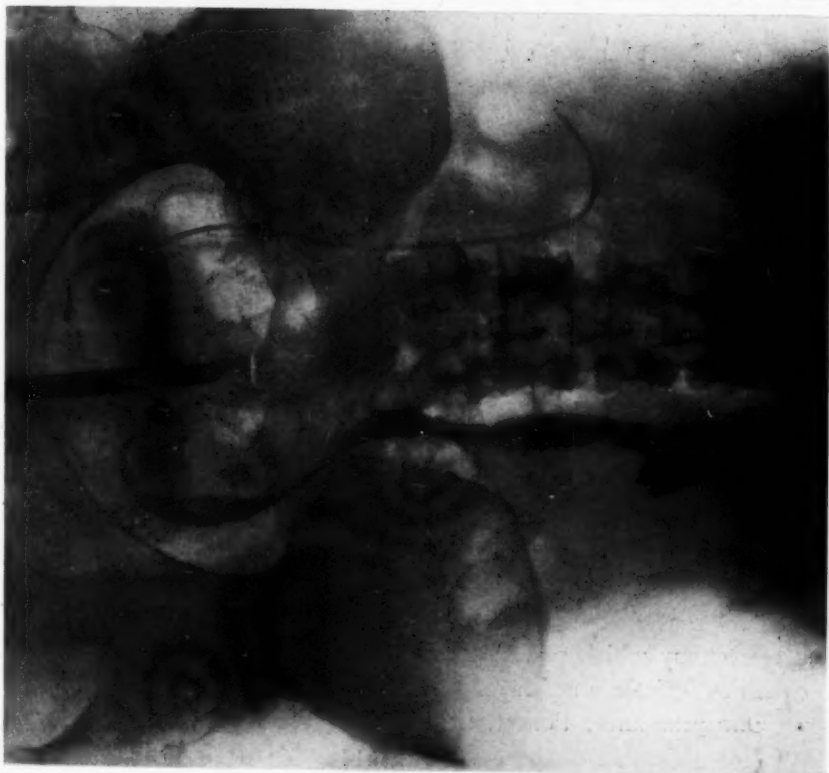


FIG. 2.—Case I. Pyeloureterogram of same case, revealing a peculiarly shaped pelvis without calyces, which gives the impression of an atrophic hollow functionless kidney with dilatation of the lumen of the ureter and a filling defect at the point where the previous shadow indicated the urinary calculi impacted in the low ureter, preventing the normal outflow. This case illustrated the convenience of primary ureteronephrectomy.

Hippocrates and the earliest days of medical science, but the operation for a complete excision of ureter and kidney, whenever it is indicated, is a relatively recent achievement of modern urology.

In fact, the first ureterectomy ever performed appears to have been carried out by Reynier, in 1892, on a patient who needed three consecutive operations, for the removal of an infected ureter stump left behind at the time of nephrectomy for pyonephrosis. Reynier's case is fully described in

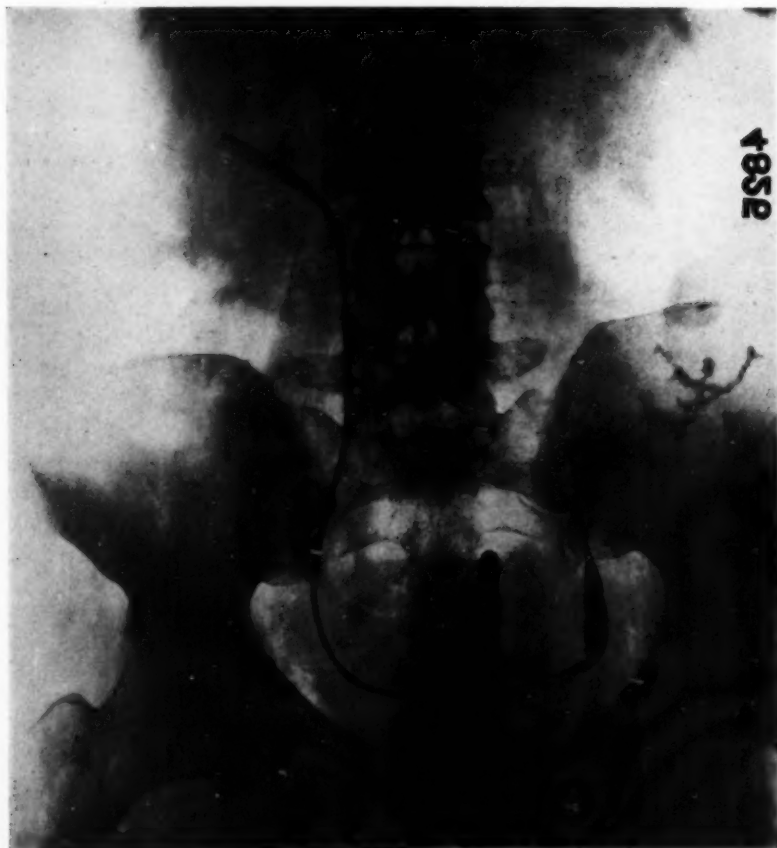


FIG. 3.—Case I. The same patient who came back to the clinic two months later, after nephrectomy and incomplete ureterectomy, complaining of uropurulent abdominal lumbar fistula due to the infected ureter stump which contained a calculus. The ureterogram reveals the injected sodium iodide coming out from the ureter to the skin, necessitating a secondary ureterectomy to obtain cure.

Rousseau's Paris thesis published in 1893. It appears that the patient had a very stormy convalescence, necessitating the three subsequent operations that were performed at different times afterward by the lumbar, sacral and inguinal routes, ending finally with the successful accomplishment of a total ureterectomy which served, I think, to open a new era for the pathological conditions of the surgical ureter.

One year later, Poncet, in a case of renal tuberculosis, thoroughly de-

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scribed in Riaudet's theses, confirmed the value of the excision of the entire length of the ureter whenever the tuberculous process has definitely involved the ureter. The case was that of a nephrostomy for a tuberculous pyonephrosis, which necessitated a secondary nephrectomy and, two and one-half years later, a total ureterectomy for a permanent lumbar sinus that apparently refused to heal even after curetting and other palliative treatments, and which undoubtedly was due to the tuberculous ureteritis of the infected ureter stump.

But it is to Howard Kelly that most of the credit must go for having performed, December 18, 1895, the first total nephro-ureterectomy in a patient twenty-three years old, suffering with reno-ureteral tuberculosis, with surprising curative results. Mention must also be made of Albarran, who, in 1898, performed ureteronephrectomy in a case of multiple papillomatous growth of the bladder, ureter and kidney pelvis, in one sitting removing the entire ureter and kidney with complete recovery of the patient. Both operations were performed retroperitoneally and by the long lumbo-ilioinguinal route of incision, with complete success.

However, this operative procedure did not gain in popularity during those early days, one reason for this being the lack of facilities for obtaining correct diagnosis and consequently proper indications.

Nevertheless, as progress has continued to grow with the perfection of cystoscopy, catheterization of the ureters, the renal function test and the use of röntgenography, the clinical conception has become more clear to the surgeons for the diagnosis of lesions involving the ureter, and even before urography was put into practice, more progress in the operative treatment of the ureter appeared to be made.

Kelly, Montgomery, Pozzy, Bovee, Noble and other gynecologists began to advocate the combined abdomino-vaginal route, first described by Kelly in 1896 for the total excision of the kidney and ureter simultaneously in cases of renal tuberculosis with pathological ureter. But this procedure, while difficult for lack of vaginal exposure at the fundus of Douglas's cul-de-sac and because of the damage it inflicted in opening the peritoneum, was promptly discontinued and later the same authors gave more attention to the previous method already described above. The purpose of this operation as performed by Kelly was to avoid the extensive cutting of the abdominal wall to divide the shock and facilitate the combined procedure by removing the vesical end of the ureter through the vagina. While good in technic, it is perhaps difficult to practice and is, of course, applicable only in the female.

Israel, Albarran, Kelly and others, therefore, were using in these days the most commonly known, long, lumbo-abdominal, extraperitoneal incision of exposure, which ran from the twelfth rib at the costovertebral angle obliquely down toward the ilioinguinal region and to the semilunar line about an inch above the symphysis pubis, cutting all layers of muscles so as to expose the whole kidney and ureter. Sometimes he started the operation from above downwards, and sometimes from below upwards, according to



the convenience of the case and with the purpose of removing the kidney and ureter *in toto*. But while good results apparently were obtained, one cannot fail to admit that such an enormous incision across the belly's wall appears altogether too drastic and may perhaps cause a weakening of the abdominal wall's resistance, perhaps resulting later on in an abdominal hernia, which patients hesitate to permit.

Later on, Hartman, Kelly, Albarran and Lilienthal, in 1911, called attention to the convenience of the two-stage combined incision of exposure by the lumbar and inguinal route for accomplishing the nephro-ureterectomy, but the procedure did not come really into vogue until Edwin Beer, in 1921, and Judd, Papin, Young, Joly, Kidd, Hunt and others reported cases, and again called attention to its convenience and the importance of its use.

After Beer's presentation, with the report of several cases without death or complications, many surgeons employed the combined method of technic in the two-stage ureteronephrectomy, serving for the removal of the entire ureter and kidney in one piece without opening, and commencing with the first step of the operation from below, cutting the ureter from behind the bladder as in the case that I am about to describe.

It is a well-recognized fact nowadays that the pathological ureter must be excised at the time of nephrectomy as low down as possible, but when the diagnosis of the lesion involving the ureter has been previously made, the operation is best handled commencing from below. In other cases when the diagnosis is not a perfectly clear proposition, the surgeon will do better to commence from the kidney and explore downwards, then make the second incision at the external border of the rectus muscle or at the inguino-abdominal region parallel to Poupart's ligament according to his preference, cutting the ureter behind the bladder between a double ligature, extra-peritoneally, in order that the kidney and ureter after blunt dissection may be pulled from above and removed *in toto*.

Although this complication of the ureter stump clinically appears to be rather common, it is surprising how few text-books have even mentioned or discussed the importance of this surgical problem. Therefore, pre-operatively, it should always be recognized that in many cases the indications for a primary total ureteronephrectomy deserve consideration as well as those for a subsequent ureterectomy and that the total extirpation in one sitting should be practiced more often than is the case today.

In the last two decades the literature of this subject has been very scarce. Besides the names already mentioned there are two important contributions worth mentioning: one, that of Henri Lorin, of the Necker Clinic, published in 1913, on the rôle of the ureter after nephrectomy, and the other, that of Raymond Lathem, in 1922, from the Mayo Clinic. Both papers are experimental and clinical studies revealing the pathogenesis of the infected ureter stump as the cause of pus and infection and calling attention to this common occurrence.

## COMBINED URETERONEPHRECTOMY

More recently a few other interesting articles of great clinical significance have enriched the literature on the subject, among which the names of Frank Kidd, Thomson Walker and Verne C. Hunt are worthy of mention.

*Indications for ureteronephrectomy.*—Since I have been studying the etiology and pathology of vesico-renal reflux in a paper that I had the honor to present before this section in December, 1928, and later before the meeting of the American Urological Association, held at Vancouver, B. C., in July,



FIG. 4.—This is the cystogram of a man thirty years of age which revealed hydroureter and hydronephrosis of the right side. With the presence of tubercle bacilli in the urine, this gave evidence of a right tuberculous kidney, for which ureteronephrectomy is indicated. However, the patient did not return to the clinic and no further data were obtained.

1929, I have come to the conclusion that much overlooked pathology of the surgical ureter and kidney is at the bottom of the necessity for this radical operative treatment.

In that paper I thoroughly discussed the value of cystography, and the congenital and acquired type of vesico-renal reflux. I also called attention to the fact that, when the kidney on one side has lost its function causing hydro-ureter and hydronephrosis, ureteronephrectomy is the only curative treatment available to the urologist, and that in many instances, when the

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ureter has been transplanted to another portion of the bladder, reflux of the vesical contents occurs and the kidney gradually becomes pyonephrotic, necessitating, in many instances, its complete removal to relieve pain and symptoms.

TABLE I

*Indications for Ureteronephrectomy, versus nephro-ureterectomy*

1. In hydronephrosis, simple or infected, where the stricture is low down in the pelvic ureter or in the intramural portion of the vesical ureter.

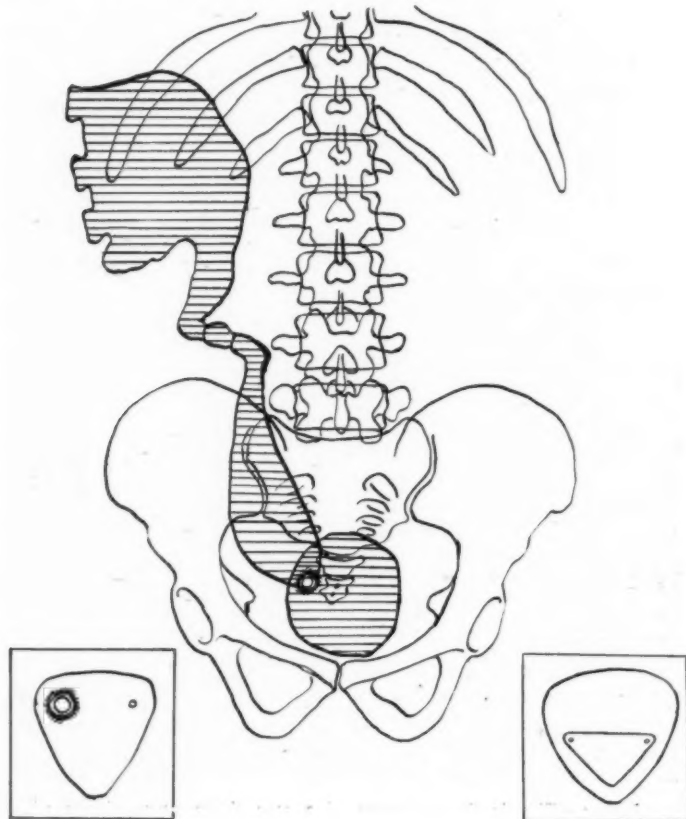


FIG. 5.—A drawing of the same case showing the cystoscopic finding of a patulous and greatly dilated "golf hole" type of ureteral orifice on the right side, the left ureteral orifice being normal. Here cystography confirmed the diagnosis of vesico-renal reflux, in which type of case, when unilateral, the combined primary ureteronephrectomy is well indicated.

2. In pyonephrosis or atrophic, hollow, septic or aseptic kidney secondary to a stone long impacted in the pelvic ureter.
3. In tuberculous pyonephrosis associated with marked ureteritis and peri-ureteritis, or definite involvement of the ueter, as in megalo-urèter and rosary-tuberculous ureter.
4. In all other types of pyonephrosis associated with fibrosis or dense inflammatory stricture low down in the pelvic ureter.
5. In cases of vesico-renal reflux with hydro-ureter and hydronephrosis, when unilateral, as:

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- a. In gaping or "golf hole" ureteral orifice due to congenital malformation.
- b. In ureteroneocystostomy when resulting in vesico-uretero-renal reflux.
- c. In persisting vesico-uretero-renal reflux after prostatectomy.
- d. After meatotomy for an impacted stone in the intramural vesical portion of the ureter when causing reflux and ascending infection.
- e. When the ureter opens into a bladder diverticulum and there is no sphincter action at the mouth of the ureteral orifice, giving place to ureterocele formation with definite back pressure, ascending infection and reflux.
- f. When the ureter has been transplanted to another portion of the bladder, resulting in vesico-renal reflux and a functionless organ.



FIG. 6.—Cystogram of a patient who had a ureterocystostomy ten years ago for malignant growth of the intravesical portion of the ureter, which it has never been possible to catheterize. In combination with urinary symptoms the cystogram revealed vesico-renal reflux with hydroureter and hydronephrosis such as almost always occurs in cases of transplantation of the ureter to another portion of the bladder, requiring the combined ureteronephrectomy (Lowsley's case).

6. In papilloma of the renal pelvis, ureter and bladder.
7. In primary carcinoma of the ureter.
8. In congenital ectopic ureter opening extravasically as in the wall of the vagina associated with congenital cystic or atrophic kidney.
9. Infected ectopic pelvic kidney with pathological ureter.
10. For stone long impacted in the lower portion of the ureter, causing complete obstruction and distortion of the whole kidney parenchyma.

11. Heminephrectomy for horseshoe kidney or duplication of pelvis and ureter, when associated with stone impacted low down in the pelvic ureter.
12. In leucoplakia of renal pelvis and ureter.
13. Primary fibro-fatty ureteritis, tuberculous or otherwise, where infection has extensively damaged the wall of the ueter, yet has left the kidney comparatively free.
14. In persisting ureteral vaginal or rectal fistula with pyelonephritic infection, and when all other palliative measures fail to obtain cure.
15. When the ureter has been transplanted to the rectum and ascending infection has developed, as could be revealed by intravenous pyelography.



FIG. 7.—Pyeloureterogram revealing filling defect of multiple papillomatosis of kidney pelvis and upper ureter, indicating the convenience of total ureteronephrectomy.

Many other types of lesions call for the veritable necessity of this radical two-stage procedure, but at this time I will not go into complete details in view of the limited time allowed for this presentation. However, while studying the subject, I have made two tables showing, in résumé form, what are the indications when the two-stage aseptic operation for ureteronephrectomy should be recommended, as I have performed it in one sitting with the most satisfactory results, removing the total specimen in one piece and without opening, thereby preventing contamination of infection. Both



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wounds of the operation healed firmly without incidents and a perfect curative result was finally attained. (See Figs. 17, 18, 19 and 20.)

Also, for practical purposes, I call attention in the second table to the incidental and true indications of a secondary ureterectomy, which I illustrate herewith in the report of my first case. (See Figs. 1, 2 and 3.)

TABLE II

### *Indications for secondary ureterectomy*

1. In infected stump of ureter due to tuberculous ureteritis and peri-ureteritis after a long period of medical and urological treatment when the cystitis and other bladder symptoms have not subsided.
2. In persisting uropurulent lumbar fistula when due to septic ureter stump and the presence of vesico-ureteral reflux.
3. In infected stump of ureter without drainage forming pyoureter or empyema.
4. In the presence of stone or foreign bodies in the ureter stump.
5. In cases of secondary papilloma implanted in the walls of the ureter stump.
6. In subsequent epithelioma of the ureter causing persisting painless hæmaturia.
7. In carcinoma of the remaining portion of the ureter after nephrectomy for renal neoplasm, and with recurrence in the intramural portion of the ureter and bladder.
8. When the cystogram reveals the presence of diverticulosis of the stump of the ureter, particularly if the diverticulum formation of the ureter is of the retentive type.
9. When the indwelling ureteral catheter and the lavage with antiseptic solution of the infected stump does not relieve the pyuria, "ureteric colic" and bladder symptoms of the aggravating condition.

It is obvious that in urinary surgery the diseases most commonly encountered in routine practice are urinary lithiasis, renal tuberculosis and malignant lesions of the bladder, ureter and kidney. There is also the rôle of infection of the upper urinary tract due to bacteria, urinary stasis and congenital malformation, such as gaping ureter, stricture of the intramural vesical portion of the ureter and abnormal extravascular supernumerary opening of the urinary duct, which, in many instances, causes the loss of its function, necessitating its complete removal. Up to the present time only the review of the literature will serve to reveal the paramount importance of these conditions that rela-



FIG. 8.—Drawing of a specimen showing hydro-nephrosis and huge diffused papillomatous growth of the entire lumen of the ureter, including the intravesical portion, which was removed in toto by nephroureterectomy. (Courtesy of Guyon Museum, of the Necker Hospital, Paris.)

tively commonly occur as a sequel to not having performed a uretero-nephrectomy at the beginning, or having done an incomplete nephro-ureterectomy.

Rafin, Poussou, Ferron, Sampson, Carraro, Legueu and Papin have called attention to the persistence of lumbar fistula after nephrectomy for renal tuberculosis in cases of vesico-renal reflux or well-advanced tuberculous ureteritis. The persistency of pyuria, pyo-ureter and marked bladder symptoms after nephrectomy have been well emphasized in the cases reported by Albarran, Israel, Escart, Rochet, Hyman, Read, Fowler, Fraustein and others. Stone formation or a stone left behind in the pelvic ureteral

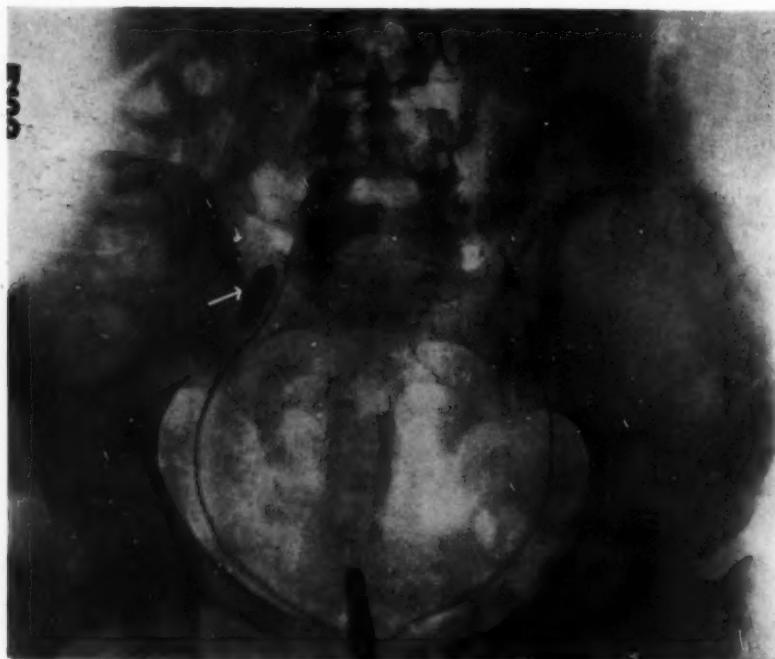


FIG. 9.—Patient is a woman thirty-four years of age, who had her right kidney removed elsewhere. After persisting pain on the right side for more than three years and other urinary symptoms, a plain roentgenogram with ureteric catheters in position disclosed the presence of a stone about the size of an olive, in the right ureter stump at the brim of the pelvis, which was presumably left behind at the time of nephrectomy.

stump is of rather common occurrence, as has been recently discussed by Kidd and Hunt and as I illustrate in this paper with the report of Case I, and the radiogram of Doctor Lowsley's case, in which a secondary ureterectomy was done to attain curative results.

In many instances the undesirable complications of common occurrence in a nephrectomized tuberculous kidney are mainly due to the involvement of the ureter as well as the bladder and surrounding structures, but frequently to the fatty capsule and to contamination of the muscular walls of the wound, together with marked tuberculous ureteritis and peri-ureteritis; so that even when the ureter is divided by the thermocautery and ligated as

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low down as possible, often the wound breaks through, the stump of the ureter loses its ligature, and starts to discharge both pus and urine through the lumbar end—which condition is known to be the most annoying complication for delaying the healing of the wound and preventing the clearing up of the bladder symptoms (which, indeed, are responsible for the frustration of what should have been an uneventful nephrectomy). Many of these very important points and observations are discussed in contributions by Albarran, Mayo, Papin, Kretschmer, Judd, Scholl, Rafin, Bocmel, Walters, Marion and other writers, thus showing that a total ureteronephrectomy is the operative procedure of choice.

Primary malignant lesions of the ureters are extremely rare. Albarran and Imbert tabulated sixty-five cases of papillary epithelioma of both the ureter and the renal pelvis, and of these only thirteen were cases of primary cancer of the ureter. Kretschner, in reviewing primary carcinoma of the ureter, in 1924, counted thirty-five cases, and reported one case of his own. Moreover, Verne Hunt recently discussed two cases from the Mayo Clinic and stated that of fifteen cases of papillary epithelioma of the renal pelvis, nine came back after nephrectomy complaining of hæmaturia from the ureter stump, due to recurrence or secondary extension of the primary lesion of the renal pelvis to the infected ureter, which necessitated secondary ureterectomy. Hunt further said, "The best prognosis may be offered when the radical operation of nephro-ureterectomy, including the intramural portion of the bladder, is done immediately after the diagnosis of papillary epithelioma of the renal pelvis is established." Therefore, as Beer also stated, when there is evidence of a pathological ureter, a combined aseptic ureteronephrectomy should always be the operation of choice, so as to avoid metastasis, hæmaturia or recurrence of the tumor or other symptoms which end in the necessity of a secondary ureterectomy.

Another condition in which this radical two-stage operation is indicated is in congenital malformation where the authors and specialist surgeons are not entirely in accord as to the best method of treatment. In cases of congenital stricture of the pelvic ureter at the intramural vesical portion, causing urinary stasis of long standing with megalo-ureter or hydro-ureter and hydro-



FIG. 10.—Specimen removed at operation of previous case, showing the shadow of the stone in the portion of the stump of the ureter removed by secondary ureterectomy with satisfactory results.

nephrosis with complete loss of function, clearly revealed by the pyeloureterogram (as in Case II, which I am here reporting), and with infection, tuberculous or otherwise, ureteronephrectomy in two stages and at one sitting is the ideal operative method of treatment.

The problem of the extravesimal opening of a supernumerary ureter, while relatively rare, is of interest. Raymond Dossot, of the Necker Clinic, has collected and tabulated from the literature 154 unusual cases, ninety-five of which occurred in females and forty-six in males, with the sex not stated in the other thirteen, in which urinary incontinence, pus and infection have been noticed from birth. The supernumerary extravesimal ureter opened in

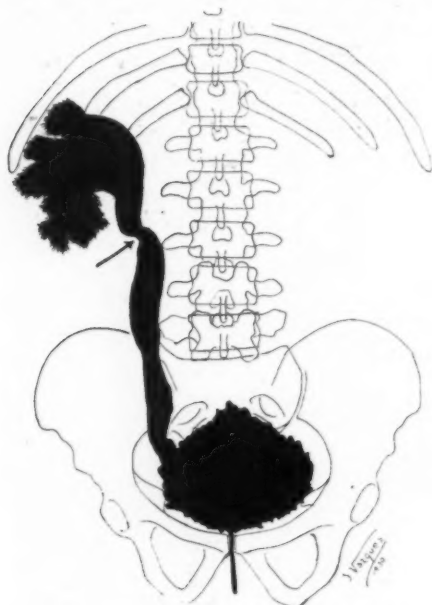


FIG. 11.—This drawing represents the incident of vesico-renal-reflux in urinary surgery, pointing to the convenience of primary ureteronephrectomy, particularly for renal tuberculosis, in order to avoid lumbar fistula and the other common complications observed after nephrectomy, when the ureter is ligated at the level of the lower pole of the kidney leaving behind an infected ureter stump.

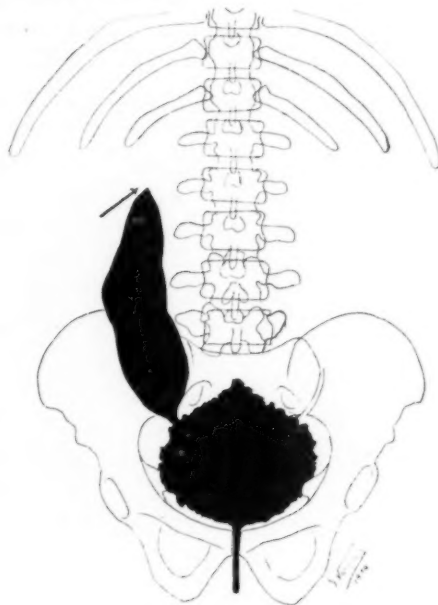


FIG. 12.—Illustrates the incident of diverticulosis formation of the ureter after nephrectomy in a case of vesico-renal-reflux of the retentive type, in which secondary ureterectomy is indicated.

the vulva forty-six times, in the urethra twenty-eight times and in the vagina fourteen times. While all these cases had been treated in different ways, many had been operated upon three and four times with consequent failure, recourse being ultimately had to nephrectomy and partial secondary ureterectomy.

Clinical experience, however, has shown that these ectopic, supernumerary or single ureters are always markedly dilated and without sphincter action at the point of their insertion, and as an evident result of this, the kidney tissue drained by them is always more or less injured and of no value physiologically. Therefore, their total removal by ureteronephrectomy is the

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only logical procedure. In some instances of a double kidney the good ureter or the one that opens normally in the bladder should be catheterized, and if there is good renal function, the catheter should be left *in situ* at the time of resection or of conservative ureteroheminephrectomy, which should be the operation of choice. Illustrative cases of this type have been reported by Albarran, Judd, Papin, Alessandri, Kidd, Furniss and other writers.

The importance of a secondary ureterectomy for the extirpation of the ureter stump left behind after the primary nephrectomy, which is, in many instances, as I have already shown, a complication of the same, needs no further emphasis at this time beyond the statement that complete removal of the ureter by total ureterectomy is justified, whenever it is diseased.

*Pre-operative measures and the anæsthetic.*—It is perfectly obvious that the case suitable for a combined ureteronephrectomy should receive the same care and attention as one for an ordinary nephrectomy, assuring, therefore, a good prognosis with the compensative renal function of the opposite side. The diagnosis must be accurate and conclusive of a functionless kidney with a clear-cut or definite lesion low in the pelvic ureter. Ureterograms and cystograms such as we make today are essential, and sometimes intravenous pyelography, when the ureter cannot be catheterized, is of real value in the pre-operative diagnosis. In other words, the surgeon must adopt the painstaking aphorism of "To plan what to do, or rather to know what to plan." Finally, before the operation the patient should be cystoscoped and an indwelling ureteral catheter fixed *in situ* in the ureter to serve as a guide to the surgeon so that he may readily locate and expose the ureter during the surgical procedure.

The anæsthesia to be employed is another problem of vital importance, particularly to patients who present poor risks due to weakness and long-standing infection, as in renal tuberculosis, or even when there is a slight

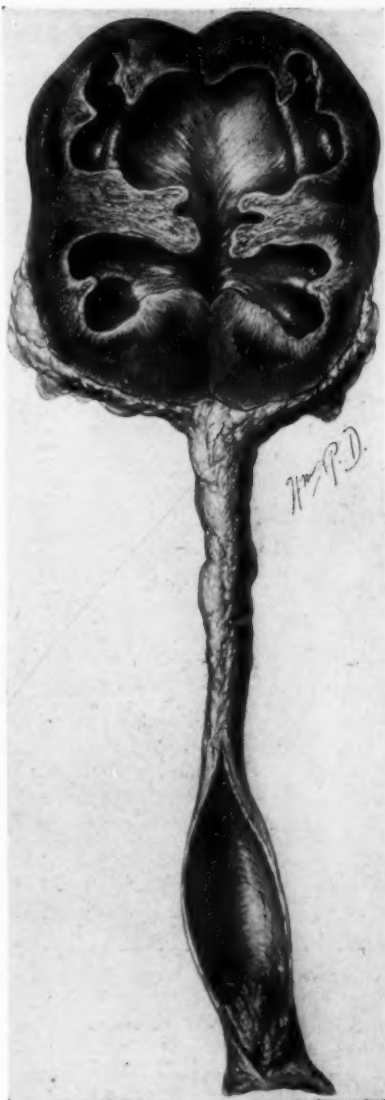


FIG. 13.—Drawing illustrates a case of primary malignant growth of the ureter removed by nephroureterectomy and shows the necessity of its total removal. (Courtesy of Guyon Museum, of the Necker Hospital, Paris.)



impairment of renal function in the opposite kidney. At the New York Hospital we have been using the paravertebral and also block method of infiltration with a solution of procaine 1 per cent. with satisfactory results. The first step of the operation can be performed with local anæsthesia, the second part being accomplished through the lumbar incision, when the

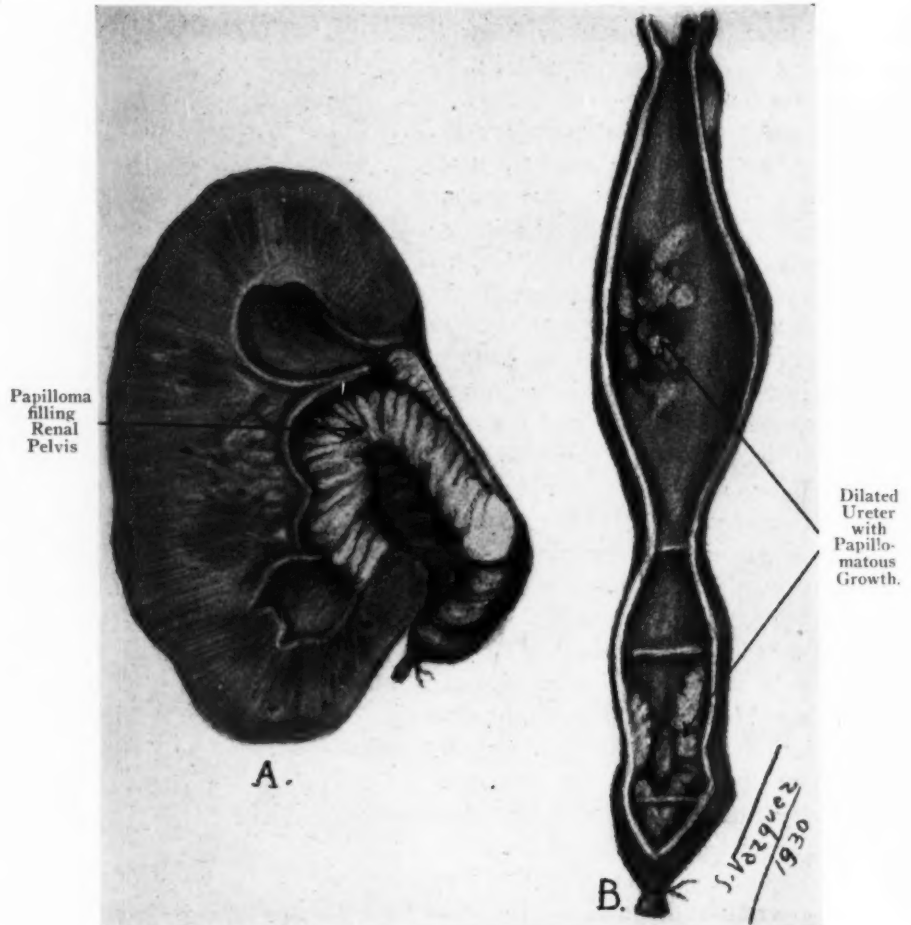


FIG. 14.—Recurrence of papillomatous growth in the stump of the ureter: a.—Patient is a doctor in whom, during an attack of painless hematuria, the pyelogram revealed a filling defect at the pelvis of the kidney, for which nephrectomy was done. b.—Two years and three months later the patient had a similar attack of hematuria, and the ureterogram revealed a filling defect for which a secondary ureterectomy was done. This case illustrates the value of the combined primary ureteronephrectomy (Walker's case).

administration of a whiff of gas and ether may be necessary. As a rule, if both procedures are carried through in one sitting, the local anæsthesia is sometimes sufficient and gives better results. The relaxation is perfect, there are no ill effects afterwards, and the recovery is prompt and uneventful.

*Surgical technic.*—As I am reporting two illustrative cases (first, one of combined aseptic ureteronephrectomy, and second, one of nephrectomy with

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subsequent ureterectomy), I feel that the operative technic will be better described separately with the description of each case.

So in this chapter I shall merely discuss the most important views of the surgical problem.

I do recommend that when the diagnosis of the pathological ureter is

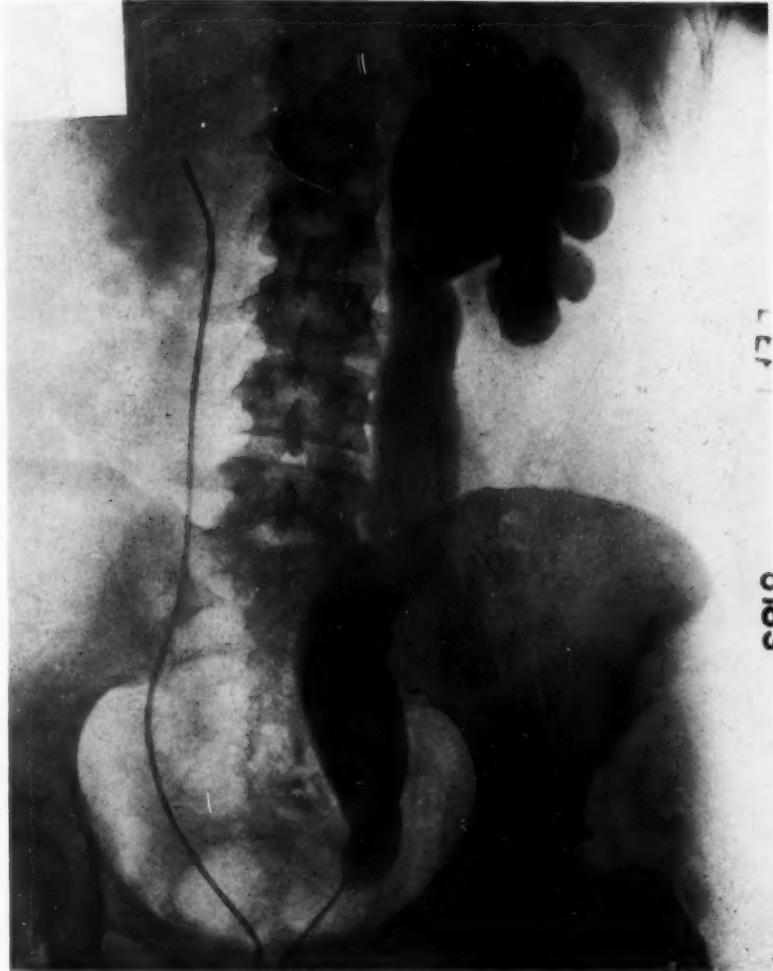


FIG. 15.—Pyeloureterogram showing an enormous hydronephrotic kidney and hydronephrosis due to a stenosis or congenital stricture of the intravesical ureter which obviously necessitates ureteronephrectomy.

well established the two-stage operation should always begin below by cutting across the ureter as close to the walls of the bladder as possible between two clamps and making a double ligature of both ends of the cut ureter as the first stage of the procedure for the combined and simultaneous ureteronephrectomy.

The incision to expose the pelvic ureter must be adequate to permit the free dissection of the vesical portion of the ureter and as the operation is

wholly extra- and retroperitoneal, the oblique incision parallel to Poupart's ligament, and running from about the level of the anterior superior spine downward to the semilunar line, five to six centimetres in length, is satisfactory and sufficient for a good exposure. With this semi-oblique incision no nerves of the abdominal wall are sacrificed. Neither the deep epigastric

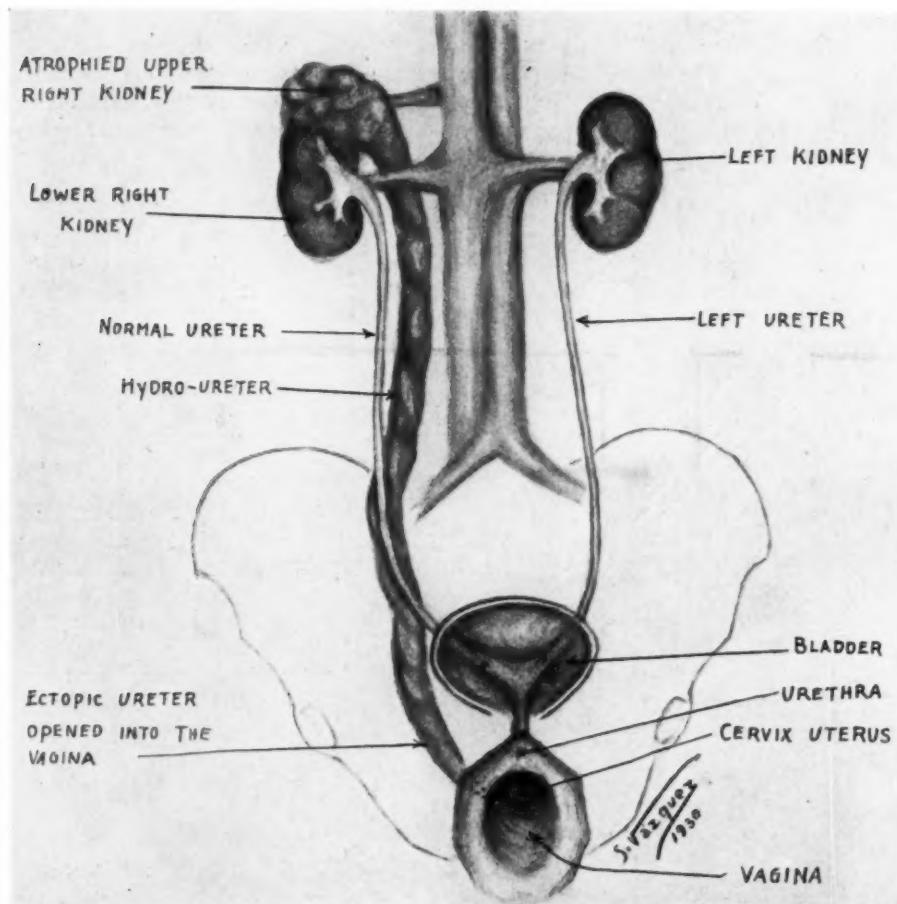


FIG. 16.—This drawing shows the congenital extravescical opening of a ureter requiring ureteronephrectomy to obtain permanent cure. The drawing illustrates the incident of a double kidney with a double ureter in which the ureter of the upper kidney opens into the wall of the vagina, associated with chronic infection, hydroureter and hydronephrosis, and a uropurulent vaginal discharge observed from birth. The other ureter of the same kidney opens normally into the bladder. This case indicates the convenience of the two-stage ureteronephrectomy or ureteroheminephrectomy (as in cases reported by Albarran, Judd, Papin, Kidd and others).

artery nor the branches of the ilioinguinal or iliohypogastric nerves are divided, so there is no danger in the future of the formation of a hernia.

The other incision that may be used in this connection is the one commonly employed in appendectomy, the transverse incision described some thirty-five years ago by McBurney, and since modified by Wier, Elliot and Dever. It is classically known as the so-called muscle-splitting operation, where the skin and the external oblique with its aponeurosis are only divided

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and the internal oblique and transverse muscle are split by the handle of the scalpel. But undoubtedly where the field is restricted it offers an insufficient exposure. In dealing with a much-diseased organ and surgical ureter *per se* the urological surgeon must have sufficient space for dissection and complete exposure of the pelvic ureter, way down to the bladder wall, since sometimes a partial cystectomy for a malignant growth of the ureter and bladder may be required. There must be room to separate the entire ureter from its attachments to the parietal peritoneum by blunt dissection and to facilitate its complete removal from the lumbar secondary incision of exposure.

There is also the vertical medium-line incision at the external border of the rectus muscle, used by a few authors, but the oblique incision as here described is more convenient and is the one that affords the best exposure and gives the greatest certainty of the extraperitoneal procedure and assures an aseptic operation with no contamination of the muscles or the abdominal wall of the anterior wound, so that the incision almost always heals entirely by primary union.

In urinary surgery all the operations performed upon the kidney, ureter and bladder are, as a rule, extraperitoneal with very few exceptions, such as those for tumors of the kidney and ectopic pelvic kidney. For this last variety, when hydronephrotic infection with stone is present, the long mid-line incision is required as in laparotomy for opening the peritoneal cavity to accomplish ureteronephrectomy transperitoneally whenever possible, as Kidd has recently shown when reporting a successful case before the Royal Society of Medicine.

In ordinary cases, the second stage of this combined procedure, namely, the lumbar incision, slightly more oblique from behind or from outside inward, is none other than the classic one of an ordinary nephrectomy: The same technic should therefore be applied, but the surgeon must bear in mind that the whole specimen should be removed *in toto*, and in one piece as soon as the ureter is isolated and pulled out; the ureteronephrectomy is an easy job. It is always convenient to drain those cases of ureteronephrectomy by leaving a cigarette drain at one end of each of the angles of the wound. For example, one may be placed below, right behind the walls of the bladder, for the purpose of securing any drainage or leakage of urine that may escape, should the double-tied ligature slip from the remaining vesical portion of the ureter or the bladder itself, while the other cigarette drain is placed in the upper angle of the nephrectomized wound close to the ligated pedicle, so as to secure drainage in case of accident. These two drains can be removed as may be convenient on the second or third day after the operation. The untouched part of the abdominal muscles which are not divided will act as a protective bridge between the two separate incisions in the event of a future eventration or hernia of the abdominal contents, particularly in the female. Another advantage is that it will divide and diminish the operative shock, which is much more desirable for the benefit of the patient. There-

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fore, these two separate incisions should be preferred to the long, single, mutilating incision used in the past.

## REPORT OF CASES

CASE I.—*Nephrectomy for functionless hollow kidney secondary to multiple stone long impacted in the pelvic ureter, necessitating, four and one-half months later, a subsequent ureterectomy in order to obtain cure of an abdominal-lumbar fistula, due to the infected ureter stump that contained a small calculus.*—Patient is an Armenian, well developed and well nourished and apparently in good health. History No. 155410. Mrs. B. D., thirty-four years old, came to the Urological Clinic of the New York Hospital referred by the Gynecological Department of the same hospital on June 6, 1928, complaining of pain in left lumbar region radiating towards the lower abdomen for over three years with slight dysuria and frequent urination.

Family history is irrelevant except that father died at forty-five years of age of pneumonia and mother at thirty of typhoid fever. Patient is married, husband living, two brothers also living and well. In the past personal history, patient had the common childhood diseases without incidents. Had an attack of pneumonia in 1916 and an abdominal operation in 1925 for appendectomy. The menstrual periods began at the age of thirteen, and were always regular until the last four years, when intervals have been every two or three weeks. Has no children and there is no history of miscarriages or abortions.

Present illness started about two and one-half years ago when she began to have pain in the left back, and occasional burning when urinating. This pain has persisted except when she is lying down. It begins soon after she moves around. She has also had for the past six months intermittent pain in both lumbar regions. No history of the patient as to actual hæmaturia or pyuria, but urine analysis shows microscopic pyuria and hæmaturia. Patient was cystoscoped on June 7, 1928, but in view of the marked cystitis the exploration was discontinued and patient was advised to return twice a week for bladder lavage until the much-infected and inflamed bladder cleared up to permit complete examination. Cultures of the bladder urine were negative. The patient was cystoscoped again on June 21 and July 2, when the right ureter was catheterized, and normal specimens from the right kidney were obtained. On the left ureter the catheter met obstruction about three and one-half centimetres from the mouth of the ureteral orifice and no specimens were collected. On July 26 patient was cystoscoped again and another functional test was carried out, and also plain X-ray pictures, left pyelogram and ureterogram taken. On August 13, in another examination, I made the same observation of marked œdema of the left ureteral orifice, and that the ureteric catheter on the left side met obstruction about three and one-half centimetres from the bladder. The specimen was collected at the same time and sent to the laboratory for examination, which was as follows:

### Report of Ureteral Specimen

	Right	Left
Character.....	Clear	Hazy
Urea.....	4.5 grams per liter	1 gram per liter

### Phenolsulphonephthalein

Appeared	3½ minutes	No time
Per cent.	0.25	0
Time	10 minutes	No time

### Microscopic Examination of Sediment

Wet specimen	epithelium, one high power field	Pus 100 per high power field
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### *Cultures of Urine Show:*

Right and left ureter and bladder negative.

The X-ray report was also of interest because it revealed multiple shadows along the line of the left ureter indicative of stone long impacted in the wall of the ureter. (Fig. 1.) There were no other shadows indicative of stone in the urinary tract. The left pyelogram shows (Fig. 2) a peculiar pelvis without calices and the ureterogram reveals dilatation of the ureter with filling defects here and there corresponding to the shadows seen in the plain pictures. The impression was that of a functionless left kidney with multiple stone long impacted in the ureter, and in view of the fact that the patient had perfectly good function in the right kidney, I advised her to enter the hospital and submit to an operation for nephro-ureterectomy in order to remove the functionless kidney together with the ureter and the multiple calculi long impacted in the same left ureter. Patient was admitted to the hospital two weeks later on August 27, and on the following day I performed under paravertebral anaesthesia a left nephrectomy with the usual technic. The much-diseased ureter containing the incrustated calculi was removed as low down as possible through the limits of the lumbar incision, and, because the patient's general condition was not very good for prolonging the operation, the incision was extended down for the complete removal of the ureter. Then a ligature was placed as low down as possible and the ureter cut across in the usual manner. Hence a ureter stump about four centimetres in length was left behind, with two cigarette drains in each angle of the wound—one around the stump of the ureter and the other in the renal fossa. The wound was then closed in layers, using catgut for the deeper structures, and the skin closed in the usual way with interrupted sutures of silkworm gut.

The small atrophic kidney, together with the long dilated ureter containing the calculi, was sent to the laboratory for examination, but, unfortunately, the whole specimen was carelessly lost. This is why I am sorry that I cannot present it on this occasion. The calculi were composed of calcium and earthy phosphates. Patient's convalescence was totally uneventful. She was up on the eleventh day and discharged from the hospital on the sixteenth day after operation, with the wound closed and in good condition.

However, about a month after the operation, she returned to the clinic complaining of pain in the lower abdomen with pyuria and frequency of urination. The nephrectomy wound had healed, but there was a small sinus at the lower angle of the line of the incision discharging a little pus and urine. Otherwise the general condition of the patient was excellent. On cystoscopy the bladder was negative, except for flakes of pus at the fundus and slight congestion throughout the bladder mucosa. The right ureter was catheterized and a clear specimen obtained. In the left ureter, from which the left kidney had been removed, the ureteric catheter entered the ureter for only about one and one-half centimetres from the mouth of the ureteral opening. The right kidney and the stump of the left ureter were irrigated with a solution of revonol dextrose 1 to 2000 with the result that the color dye injected in the stump of the left ureter came through the abdominal-lumbar sinus. The patient was treated cystoscopically on several occasions by irrigations of the stump of the ureter, dilatations with bougies, manipulations with the corkscrew ureteric bougie, and fulguration of the intramural ureteral orifice, with the hope of removing an incrustated stone lying in the pelvic ureter; but the stone did not pass and the fistula and other urinary symptoms persisted. In order to corroborate the clinical findings, plain X-ray pictures and ureterograms of the ureter stump were taken, which revealed the presence of the incrustated calculus in the lower ureter; and the injection of sodium iodide showed a persistent fistula from the ureter to the skin. (Fig. 3.)

As the patient did not improve and the lumbo-abdominal fistula continued to discharge pus and urine, besides being painful and troublesome, she was admitted to the hospital again on January 8, 1929, for a secondary ureterectomy done with a view to

removing the calculus and the infected ureter stump in order to relieve the symptoms and cure the complication of the uropurulent abdomino-lumbar fistula.

*Operation for secondary ureterectomy.*—Ether anaesthesia was administered in the usual manner, the patient having been previously cystoscoped and a No. 6 ureteric catheter left *in situ* in the stump of the left ureter.

A left inguinal incision was made about four inches long through skin and fascia. Muscles and other tissues in this region were separated by blunt dissection until the wall of the bladder was exposed. In the course of this dissection a small opening was made into the peritoneum, which was sutured up immediately. During the attempt to dissect the fistulous opening the peritoneum was again opened and was again sutured together before proceeding with the rest of the operation. After the bladder wall had been exposed it was possible to locate the stump of the ureter, which contained the small stone diagnosed at a previous cystoscopic examination. The ureteral catheter which had previously been placed in the stump was finally located, but dissection of the surrounding tissue was rather difficult on account of its location. Finally, however, the ureteral stump itself was located and freed from its surrounding tissues, and the bladder wall opened. The finger was now inserted into the bladder and the ureteral orifice located, which made the dissection easier. The stump of the ureter was grasped by a pair of Allis forceps and a small incision made, removing the stone with a piece of the ureter. Two stones were readily found, which were slightly adherent. They were removed with a piece of the stump of the ureter; the stump wound was cauterized with carbolic and alcohol and left without suturing. A counter incision was made about ten centimetres to the left of the mid-line and about midway between symphysis and umbilicus.

A suprapubic catheter was placed for the purpose of drainage since the bladder had been opened. Several cigarette drains were placed in the left lower quadrant, for the purpose of draining this area.

The incision was closed in layers using plain catgut for the muscle and fascia and silkworm gut for the skin.

Patient returned to room in good condition. She had rather a slow convalescence and the wound drained profusely through the cigarette drain, but no urine came through, due to the fact that the suprapubic tube drained very well. On the ninth day after operation the suprapubic tube was removed and a catheter was put in the urethra to secure drainage and promote the healing of the wound. On the thirteenth day, temperature was normal and the wound was still discharging pus. However, the patient's general condition was excellent. The indwelling urethral catheter was removed on the twenty-third day after operation and four days later the wound appeared to be almost healed, and the patient, having normal temperature and feeling well, was discharged as cured.

She has been coming down to the clinic for bladder lavage, but the wound is firmly healed, her general condition is good and the bladder cystoscopically appears to be normal.

*Résumé.*—This patient had a long history of suffering and discomfort due to the pathological condition of the ureter resulting in kidney atrophy. While she responded very well to the operations that were performed on different occasions, in order to bring about permanent cure, the incidents of this case illustrate well how much more advantageous it would have been for the patient and how much easier for the surgeon if the diseased kidney and the ureter in its entire length had been removed all in one sitting, thereby sparing the patient the common complications observed from the infected ureter stump.

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CASE II.—*Combined ureteronephrectomy for tuberculous, functionless kidney with megalo-ureter, carried out for the total removal of both the diseased ureter and kidney in two stages and in one sitting.*—Miss B. L., a thin, rather feeble-looking young girl, seventeen years old, on September 25, 1929, came to the Urological Department of the New York Hospital accompanied by a social service worker who stated that the patient had been suffering with pus in the urine and frequency of urination for the last ten

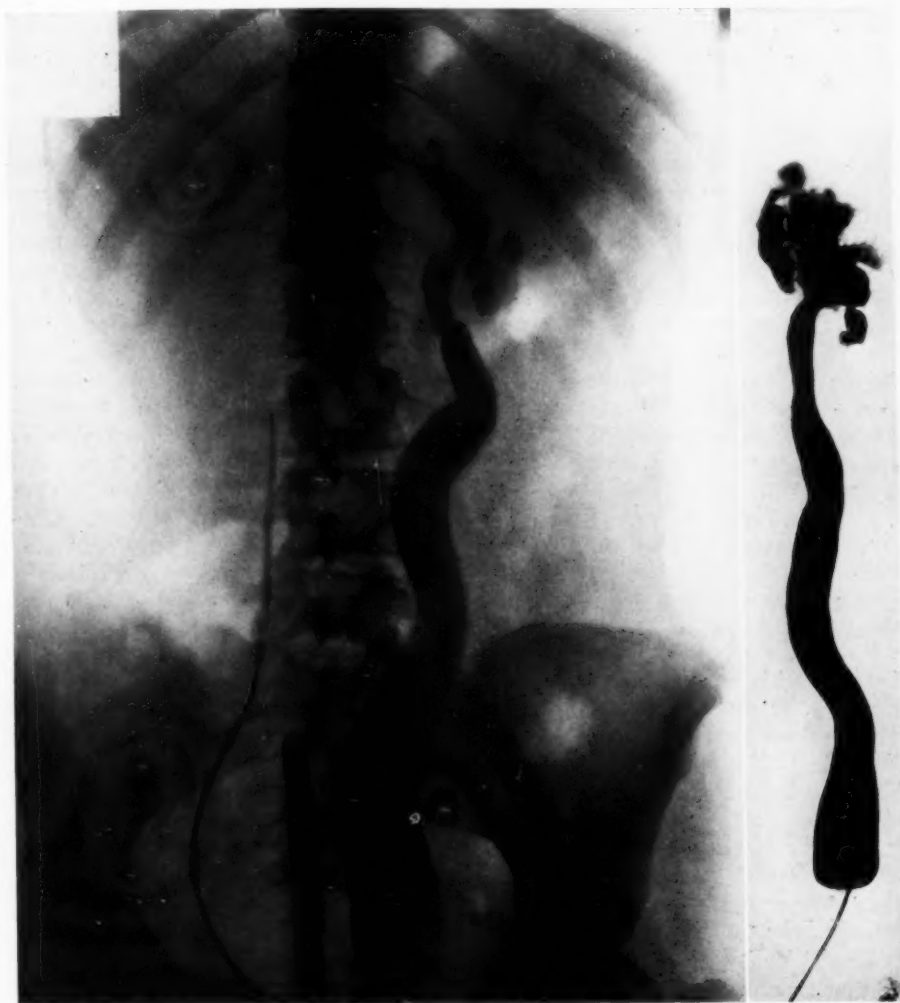


FIG. 17

FIG. 18

FIG. 17.—Case II, Ureteropyelogram revealing the presence of megalo-ureter or hydropyoureteronephrosis without function. Author's case as herein reported, illustrating the indications for a combined primary ureteronephrectomy.

FIG. 18.—Ureteropyelogram of the kidney and entire ureter both successfully removed in one piece and without opening by combined ureteronephrectomy (Author's case).

months and that she had been examined and cystoscoped elsewhere but no definite diagnosis or explanations of her symptoms had been made.

*Family History.*—Patient is single, father and mother living and well, has two brothers and two sisters, all living and well also, and there is no history of tuberculosis in the family.

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Past personal history is of interest in that the patient had been treated for cardiac disease for over eight years and that three years ago she was in a hospital for a nervous breakdown condition and rheumatism.

A year ago patient had an attack of cystitis with fever and frequency of urination and was confined to bed for two weeks, at which time she was treated with urinary antiseptics. At present she says she can walk moderately fast on a level without embarrassment, but she cannot run or go up steps without becoming short of breath. There is no cough or hæmotypsis. Tonsils had been removed. She had also suffered at times in the past, with dysmenorrhœa and amenorrhœa. With ovarian extract medication she had come back to her normal menses.

After I took the above history on the day of her arrival at the hospital, I cystoscoped the patient and was able to find the interior of the bladder chronically inflamed, with a considerable amount of flakes of pus lying at the fundus and much redness and congestion throughout. The ureteral orifice on the left side was markedly œdematous and swollen, giving the impression of a certain degree of ureterocele or that of an impacted stone in the intramural portion of the ureter. Both ureters were catheterized, a specimen from each side and also one from the bladder were sent to the laboratory for cultures, urea and microscopic examination, and patient was advised to return in a week's time to prepare for the urographic examination.

One week later, September 30, cystoscopy confirmed the previous finding, with definite impression of good phenolsulphonephthalein output from the right kidney, while there was practically no function on the left side. Plain X-ray pictures and left pyelogram were taken, injecting about fifty-five cubic centimetres of sodium iodide 20 per cent. with patient in the erect posture for the ureterogram. The X-ray report shows no shadows indicative of stone in the urinary tract, but the left ureteropyelogram (Fig. 17) reveals a much-destroyed kidney pelvis with a tremendous megalo-ureter or hydro-uretero-pyonephrosis, giving the impression of tuberculosis of left kidney and entire length of ureter, for which operation patient was advised to enter the hospital.

*Operation.*—October 11, 1929, using paravertebral anæsthesia and block infiltration with procain 1 per cent., and having previously cystoscoped the patient for the purpose of leaving the indwelling ureteric catheter fixed in the left ureter, with the patient in a slight Trendelenberg position, a left abdominal oblique incision was made about five centimetres long at the outer border of the left oblique abdominalis muscle, and running from McBurney's point obliquely inward and downward to a point about the semi-lunar line. The incision was carried through the muscle and outer border of the peritoneum, this serosa being separated bluntly to find the ureter adherent and behind it. The much-dilated ureter containing the indwelling catheter was then isolated from the peritoneum and other structures of the lower pelvis. The round ligament and the uterine artery were dissected away, and neither structure divided. The ureter was exposed down to the bladder and ureteric inlying catheter pulled out from below by an assistant; then the ureter was divided between two clamps placing a double ligature on each end of the ureter. Both proximal ends of the ureter were cauterized with carbolic and alcohol and the upper free ureter was covered with several pieces of gauze and dissected upward as high as possible so that it could be reached entirely from above during the second stage of the operation or through the lumbar incision for the total removal of the kidney and ureter. The divided free ureter was then replaced in the wound and the incision closed by layers in the usual manner, leaving a cigarette drain placed down in the lower angle and directly behind the bladder. (Fig. 19.)

For the second stage of the operation the patient was turned over on her right side, fixed for kidney position. A left lumbar incision about seven centimetres long was made running from the costovertebral angle at Henle's ligament obliquely downward and outward about three or four fingerbreadths above and away from the upper edge of the iliac crest and the part where the first abdominal incision was made, so as to leave a

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bridge of abdominal tissue and muscles undivided, separating the two incisions, this being done to preserve a point of resistance in the abdominal wall.

After incision of the superficial tissues and the plane of muscles of that region, the transversalis fascia was divided and then the perirenal fatty capsule incised from behind and split lengthwise by the fingers. The kidney was found small and adherent, and the diseased ureter, already free from its attachments, was readily identified and delivered after further blunt dissection. (Fig. 20.)

To free the upper and lower poles of the kidney the pedicle was clamped and a double ligature made, removing the kidney and ureter all in one piece and without opening. All bleeding points were tied and the wound thus dry, was closed in the usual manner by layers, leaving a cigarette drain down in the renal fossa and at the upper angle of the lumbar incision. Patient returned to the ward in good condition and after an uneventful recovery in twenty-seven days left the hospital in good condition.

The post-operative care was satisfactory, the cigarette drain was removed on the fourth day and the stitches on the sixth day. The first abdominal incision healed by primary union without incidents while the renal wound discharged pus for several days, delaying the complete healing of the lumbar wound. However, the patient left the hospital with the wound closed and in excellent condition, and went to the country for convalescence.

I cystoscoped this patient two months after she left the hospital and found her bladder free from symptoms. Recently (about seven months after the operation) I have seen her again. She is enjoying good health, has gained thirty-four pounds, and is free from urinary disturbances.

*Résumé.*—This case illustrates the value of a combined ureteronephrectomy and the convenience of employing this method of a two stage operation in one sitting, which is suitable for cases of this type, and which, although it appears to be radical, is in reality a conservative procedure and is a means of obtaining permanent cure without complications or the common troubles caused by the infected ureter stump.

### SUMMARY

In summarizing this study in a practical way, as the writer proposes to do, attention must be drawn to the most important clinical and surgical features of this operative procedure as a means of permanent cure at a single sitting, saving the patient from prolonged suffering, and shortening the time of convalescence. Among the many advantages of the two-stage ureteronephrectomy are: first, it divides the operative shock by the two separate incisions; second, it preserves the resistance of the abdominal wall against herniation; and third, by cutting across the ureter behind the bladder in the lower abdomen, in the first stage of the operation, it makes the surgical procedure one of very simple technic and one that is anatomically avascular, a very important consideration, since, this being an aseptic operation, the wound heals by primary union.

There is no handicap of contamination of the walls of the wound carried downward from the already infected kidney because, being in two separate and distinct fields, the procedure affords less chance of reinfection or of any damage being done to the peritoneum in opening it. The operation is quickly accomplished and the patient does not experience any greater



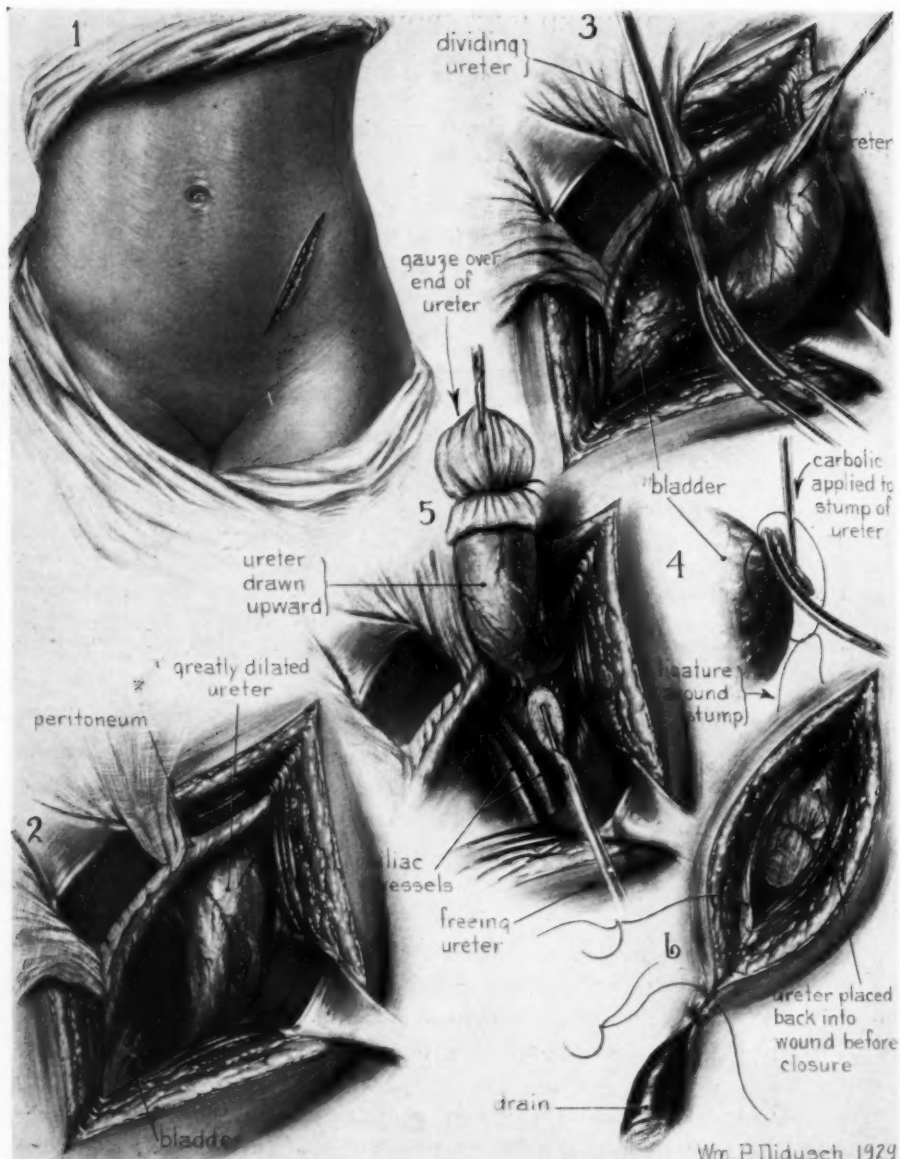


FIG. 19.—Operative technic—first stage. (1) With the patient slightly in the Trendelenberg position, an incision is made running from McBurney's point obliquely down to the semilunar line, cutting the skin and superficial aponeurosis of the external oblique and internal oblique muscles, in the direction of the incision. The peritoneum is then exposed and gently retracted by blunt dissection, thus separating it from its pelvic attachments. (2) The ureter containing the indwelling catheter is now readily identified and is always found closely adherent to the retracted portion of peritoneum. By still further blunt dissection the ureter is easily isolated down to its junction with the bladder practically without cutting any blood vessels. (3) The indwelling ureteric catheter is pulled out from below by an assistant and the diseased ureter greatly dilated is retracted and readily exposed down to the point where it reaches the bladder wall; two clamps are then fixed in position and the ureter divided, the field being covered with gauze to avoid any possible drop of urine or contamination. (4) The divided ureter is cauterized with carbolic and alcohol and a double ligature of the stump of the ureter made very close to the bladder wall, letting the bladder drop back into the pelvis. (5) The other end of the divided ureter is also ligated and a piece of gauze wet in alcohol tied around it to prevent any leakage of the ureter contents that might lead to contamination of the wound. The ureter is then dissected upward and separated from its attachments to the peritoneum and other structure, so that it will be entirely loose and ready for its removal from above during the second stage of the operation. The anatomical exposure is very satisfactory; the widely dilated ureter is easily freed and practically no bleeding is encountered. (6) The ureter is then placed back within the wound before closing, leaving a small cigarette drain at the lower angle and just behind the bladder for the purpose of securing drainage if any leakage of urine should occur. The wound is closed in layers in the usual manner. A dressing is applied and the patient is turned over and prepared immediately for the second stage of the combined uretero-nephrectomy.

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reaction than in an ordinary nephrectomy. Finally, the surgeon feels sure that he has accomplished his duty and that obviously the patient will not have reflux, lumbar fistula, pyuria, hæmaturia, colic pain, bladder discomfort or any other complications or sequels from the infected ureter stump which, in many instances, are revealed later. We must also not forget that the science of surgery is a specialized art. It is therefore essential that we should try to preserve the body's lines in an artistic manner. Thus the two separate incisions both afford safety and also give sufficient room for a perfect anatomical exposure. By not cutting entirely across the belly walls with the long single lumbo-ilioinguinal incision, we achieve the result that the undivided muscles, nerves and blood-supply will not only keep the body's lines in a more artistic and efficient manner, as is desired, but will also serve for the preservation of better function in years to come.

My first case report shows how difficult for the surgeon, and particularly for the patient, after a long period of suffering, is a secondary operation for ureterectomy when the ureter is chronically inflamed and densely adherent to the peritoneum, bent down, or plastered to the lower pelvic structures. It further calls attention to the troublesome sinus infection and scar-tissue formation from the previous operation which sometimes limit the operative field and make impossible any ligature in the low ureter. It emphasizes the continuous fear of working under difficulties and the risk of damaging the bladder or peritoneum or even the iliac vessels—complications which the surgeon must try to avoid. As the patient is put in the exaggerated Trendelenburg position during the first stage of the ureteronephrectomy, the peritoneum is loosened and easily retracted and protected with gauze, so that the abdominal contents are readily pushed back, giving a clear anatomical exposure which makes the whole procedure easier and more feasible. The report of my second case illustrates the practical surgical conception of this combined method of ureteronephrectomy in which the diseased ureter, clearly recognized before the operation, and the pathological kidney, all "en masse," could be removed in one sitting, in one piece and without opening, thus conforming with the paramount desideratum of carrying out an aseptic operation. During the first stage (Fig. 19) of this combined ureteronephrectomy, as I illustrated in the report of my second case, the ureter, which is always adherent to the parietal peritoneum, is readily identified by the palpation of the indwelling ureteric catheter previously placed in position by cystoscopy, which facilitates and shortens the procedure even in the most difficult cases to be encountered.

A survey of the literature, as well as the clinical experience of other authors, leads to the conclusion that probably an increasing number of these complications observed after nephrectomy could successfully be prevented by the use of this combined surgical method. If certain principles of surgical interference could be recognized, this method which, although radical in principle, is conservative in essence, could without any doubt in my mind be employed more widely with full confidence in the safety and convenience

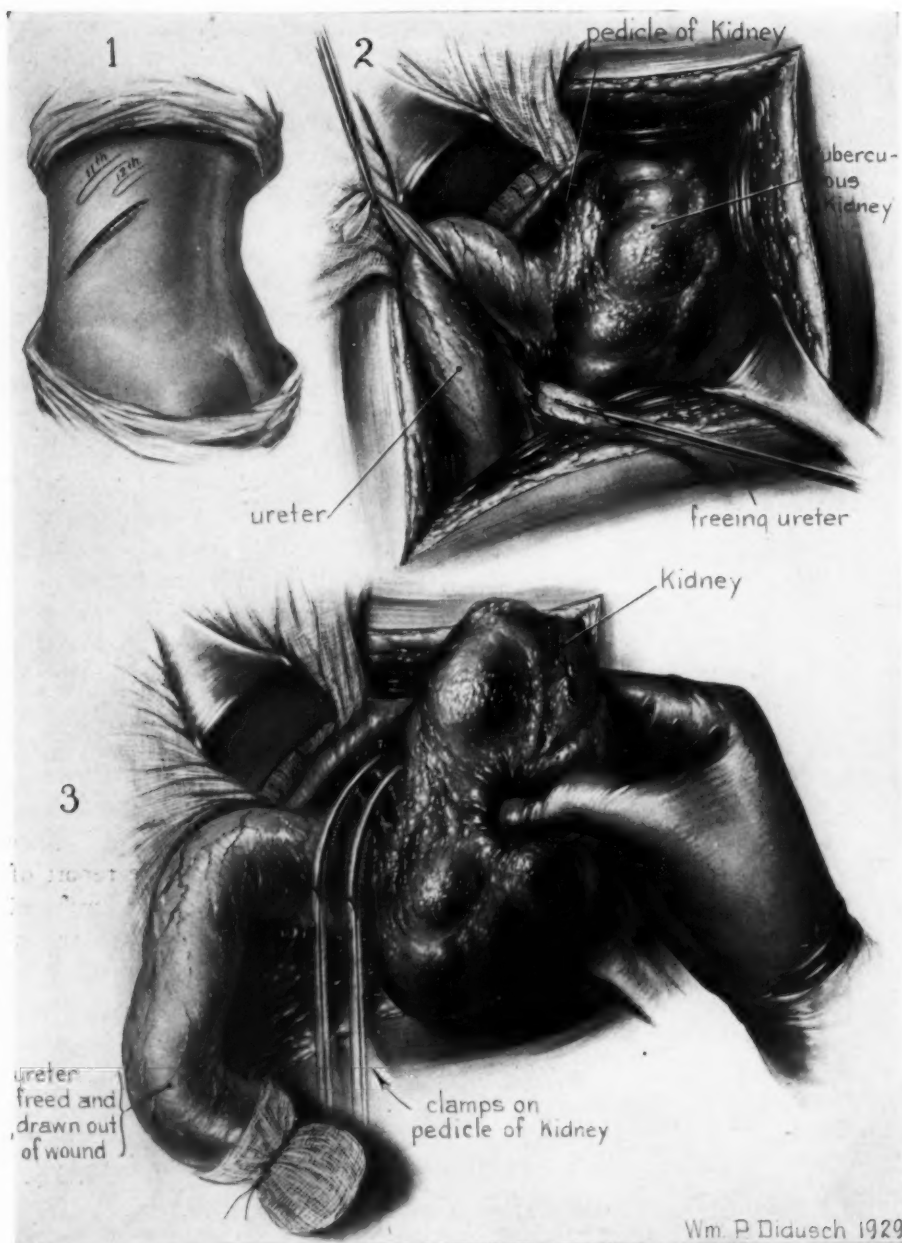


FIG. 20.—Operative technic—second stage. The patient is placed in the usual position for kidney operation and an oblique lumbar incision is made from the costo-vertebral angle about four finger breadths from the crest of the ilium and from the previous abdominal incision. The skin, muscles and aponeurosis are cut through and the fatty capsule is opened from behind. The upper and lower poles of the kidney are liberated and the ureter is exposed, retracted, and then easily, by blunt dissection, pulled out and brought entirely free of the wound. With the kidney pedicle clamped and tied in the usual manner, the total operation for combined ureteronephrectomy is therefore accomplished. The lumbar wound is closed by layers, leaving a cigarette drain at the upper angle of the wound, lying in the renal fossa. The operation is then finished in the usual manner as in any other type of nephrectomy. On the whole the technic of the combined operation is a simple one and shows a complete and most satisfactory view of all the steps of the surgical procedure, which can be carried out without producing any more shock than that of an ordinary nephrectomy, and the result obtained by this combined method is sound and gratifying.

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it affords and in the satisfactory final results which clinical experience has amply confirmed. Thus the mortality of this combined method is practically as low as in nephrectomy for renal tuberculosis, in which the figures are only about 2 per cent. while the complications to follow are indeed greatly diminished. This procedure deserves to be strongly recommended whenever there is a correct indication for it, precisely because one of its features is the avoidance of possible complications arising from the useless remaining portion of the ureter. By both clinical and animal experimentation it has been proven that a period of from nine months to three years must elapse before the ureter stump loses its physiological rhythmic contractions and becomes an aberrant atrophic cord of tissue without function or clinical significance, as always happens in an ordinary nephrectomy when the ureter is not diseased or involved in the pathological process spreading from the kidney to the outflow.

Another vital reason for primary ureteronephrectomy is, as I have already mentioned, that in this era of modern urology with the aid of urography the diagnosis must be made definitely before the operation is carried out, so that the surgeon may know in advance of operation what to plan for the benefit of the patient, and not as in the past make the diagnosis at the operating table. In the latter case the surgeon may have to start from the kidney down for the purpose of investigating the condition of the organ first, instead of reaching first for the ureter from below, which is so simple and gives so much more confidence as to the final results. Furthermore, I feel sure that combined ureteronephrectomy deserves wide application because many of the common complications observed after nephrectomy and the urinary symptoms that follow could be entirely avoided by the use of this aseptic and safe procedure which guarantees a sound prognosis.

In Table I, I discuss briefly the most common indications for primary ureteronephrectomy *versus* nephro-ureterectomy, and in Table II, I summarize the complications that are mostly always clinically recognized and that, in many instances, necessitate a secondary ureterectomy. But I wish to emphasize the value and importance of primary ureteronephrectomy as against the unnecessary danger and difficulty of a secondary ureterectomy which, even when it is indicated and must be performed, always represents a loss of precious time and strength that patients deserve to have in order to obtain permanent cure and to leave the hospital in the shortest possible period of time.

In many instances, at the time of the operation for nephrectomy the ureter could hardly be exposed or its pathology detected in its lumen. Also, because of the anæsthesia or owing to the patient's condition being critical, there is no time to prolong the incision downward in order to explore or extirpate the pelvic ureter. The true fact is that with a definite urographic and functional diagnosis, all the damn foolishness and handicap of the situation could be definitely avoided by taking the ureter first from below (Fig. 19) by the abdominal extraperitoneal incision under regional anæsthesia, and accom-



plishing immediately afterward the second stage of the combined ureteronephrectomy by the usual lumbar incision of an ordinary nephrectomy. (Fig. 20.) This I have tried to illustrate with the report of my second case, where the final results obtained were satisfactory and most gratifying.

#### CONCLUSIONS

1. Combined ureteronephrectomy in one sitting and in two stages is a practical and feasible operation that should be performed whenever the ureter is diseased or involved in the pathological condition of the kidney.

2. The pre-operative diagnosis and recognition of the clinical entity is most essential, and for this cystograms, ureterograms, pyelo-ureterograms and pyelograms are indispensable. Moreover, when catheterization of the ureters is impossible, intravenous urography is decidedly helpful.

3. The most common indications for ureteronephrectomy are described in Table I, and the sequels or complications caused by an infected ureteral stump left behind at the time of nephrectomy, which requires a secondary ureterectomy, are summarized in Table II.

4. The operative technic of ureteronephrectomy *versus* nephro-ureterectomy is herewith described, and the convenience and advantages of the two-stage operation are discussed.

5. Many of the common complications of the nephrectomized wound, particularly in renal tuberculosis, are due to secondary infection, bacillosis of the muscular walls, trauma during the surgical procedure from lack of exposure, secondary abscess formation in the renal fatty capsule, and the infected ureteric stump left behind at the time of nephrectomy.

6. In about 18 per cent. of all surgical conditions of the kidney the ureter is involved and its total removal is indicated. Therefore, whenever the ureter is diseased its entire length should be removed *in toto* by ureteronephrectomy or by ureterectomy subsequent to nephrectomy.

7. The cause of the delay in healing of a nephrectomized lumbar wound, in addition to infection and contamination, is in many instances an infected stump ureter; also the phenomenon of an uropurulent lumbar fistula or urinary reflux after nephrectomy, on that side, is due mainly to a patent ureter or tuberculous ureteritis of the ureteric stump.

8. When the diagnosis is perfectly established and the surgeon plans to remove kidney and ureter in one piece without opening it, the first step of an aseptic ureteronephrectomy should start from below, cutting the ureter behind the bladder, in such a way that the second stage through the lumbar incision may serve to accomplish the complete removal.

9. In tuberculosis of the kidney, as well as in any other pathological condition that necessitates its removal, if the ureter is not involved or diseased, nephrectomy alone will bring about permanent cure.

10. The useless stump of the ureter left behind after nephrectomy, if not diseased or involved in a true pathological process, gradually becomes atrophic, its lumen obliterated, and the whole is seen as a fibrous, function-



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less cord in from nine months to three years as clinical observation and animal experimentation have demonstrated.

11. It is obvious that the best indication for a combined ureteronephrectomy is, in addition to a clear-cut diagnosis, the assurance of a sound kidney with good function on the opposite side.

12. This surgical procedure of combined ureteronephrectomy is sound and conservative, has definite indications and affords permanent cure.

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## EXTRAVASATION FROM THE URETER

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EXTRAVASATION at any level of the urinary channel commonly precipitates a surgical problem of immediate and grave significance.

The condition is usually the result of some external traumatism and most frequently involves the lower tract, though no segment of it is immune. The septic and gangrenous individual whose urethra has been torn in an accident or punctured by violent instrumentation is the occasional dreaded visitant of every urologist. Crushing injuries to the pelvic girdle not infrequently result in damage to the bladder with an escape of its contents into the tissues. The renal pelvis may share the injury which fractures a kidney or may be torn from its attachment to that organ; a hydronephrotic pelvis may be ruptured when suddenly subjected to great compression. The size, structure, and location of the ureter make it the least vulnerable zone in the urinary system, but extravasation may result here also from bullet or stab wounds, from damage in the course of operations upon adjacent structures, and from over-zealous manipulations with ureteral bougies, dilators, and metal stone-extractors.

The extravasation which occurs in the absence of any of these external forces is much more unusual. Perhaps the most common illustration of this type is the sweeping infection which sometimes results when periurethritis has caused a mucosal break sufficient to allow just enough urine to get through to inoculate the tissues with streptococcic or anaërobic organisms of intense virulence. More rarely, so-called spontaneous rupture of the bladder is encountered, usually as the result of the efforts of its own musculature to overcome some obstruction, such as an hypertrophied prostate; a case of this sort with the discharge of the entire bladder contents into the peritoneal cavity was reported by the writer some years ago. Most rarely of all the ureteral or pelvic wall may yield to some force acting from within, and it is this particular aspect of the lesion of extravasation which will be discussed in connection with the description of three cases.

*Etiology.*—A rather hurried consultation of the literature has been almost barren of results. Data doubtless exist dealing with reports of similar cases but it has not been easily available. Young discusses ureteral trauma at some length, but only with reference to external violence; and the same is true of a recent article by Legueu. Lower and Belcher refer very briefly to the well-known but rarely encountered possibility of tubercular ulceration through a ureter with fistula formation. In an admirable review of the surgical importance of the ureter Kirwin has no mention of the condition under consideration here. Wallenstein discusses urinary extravasation at

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varying levels, reports a series of cases, and includes one of great interest involving the renal pelvis. Twenty-five years ago, Henry Morris referred in so many words to ulceration from calculous or tuberculous ureteritis as one of the causes of ureteral fistula. With his customary insight and vividness of expression Keyes goes clearly to the point. Declaring that the pathology of calculus in the urinary tract consists of retention, ulceration, and infection he says:

"Ulceration occurs at whatever point in the calyx, the pelvis, or the ureter a stone may rest. If the stone is small and movable the ulceration may be insignificant. If it is large or impacted the ulceration may be so deep that actual perforation occurs, permitting the stone to escape from the kidney, the pelvis, or the ureter into the surrounding tissues. This complication, associated as it is with urinary extravasation, is as unusual as it is grave." And again when enumerating the possible effects of a stone within the ureter: "The ureter ruptures by (a) acute gangrene or (b) ulceration about an encysted stone. The result is usually acute retroperitoneal phlegmon, infiltration of urine, abscess, fistula. Rarely an encysted stone escapes silently into the retroperitoneal tissue."

This quotation from Keyes seems to describe accurately the etiologic ground work of all our cases and will be adopted as the basis for discussion without any further consideration of other possible but very remote causes of ureteral extravasation arising from within.

*Symptoms and Diagnosis.*—The clinical picture will usually, at the moment, be dominated by the evidence of sepsis of some degree due to the infection that almost inevitably attends urinary extravasation. If the condition is progressive and active the patient will be desperately ill and urgently in need of intervention. If, on the other hand, local tissue reaction has effected a walking-in of the process the situation will be less dramatic and will in many respects simulate the perinephritic abscess better known in association with other causes. Actually, as Keyes indicates, an encysted stone may escape "silently" into the tissues and produce no local or general disturbance of any moment, but this must be quite rarely true.

The antecedent history will be of great significance and, as might be presumed, will be concerned especially with one or more attacks of severe renal pain (or colic) due to the presence of calculus in the ureter. Vesical disturbance may or may not be present, and the urinary microscopic findings, if any analysis has been made in this stage, may be indicative of trouble in this area.

When a septic patient with this previous history of renal colic presents himself and physical examination discloses muscular rigidity and marked tenderness in the renal area anteriorly and posteriorly—or a palpable mass—ureteral extravasation may be suspected but probably will not be, owing to the rarity of the condition and the uncertainty of such a diagnosis. Even when a preliminary X-ray plate defines a suspicious shadow in the neighborhood it is more likely that the condition will be considered due—as is



generally the case—either to acute diffuse renal infection or to ureteral block with acute retention in the pelvis. The urologist will therefore be disposed to make prompt cystoscopic exploration with the hope of relieving such a block, if present, and preventing disaster to the kidney, pending such subsequent attention to the calculus itself as circumstances may dictate. If it be found impossible to reach the kidney with a catheter the further course of the case will probably lead to exploratory operation and the drainage of a supposed perinephritic abscess, the true condition coming to light later if at all. If, however, the catheter can be advanced to the pelvis or the zone of extravasation purulent urine or actual pus will be evacuated and the urologist will probably content himself with this for the time being, awaiting the subsidence of fever and sepsis before proceeding by means of pyelography to obtain a better definition of the local situation. During this interval the diagnosis will remain undisclosed since it is dependent entirely upon pyelography. The latter may be hastened by failure of the patient to improve under catheter drainage; or the urologist, for reasons that appear sufficient to him, may deliberately undertake primary pyelography at the outset, which usually is undesirable, sometimes dangerous, in the presence of acute renal infection, but which under certain unusual circumstances may be much less undesirable and dangerous than either delay or blind exploration. It may be objected that with ureteral extravasation—if one could anticipate its existence—pyelography is never justifiable, but with this viewpoint the writer is not in agreement. The distribution of a small amount of sodium-mercuric iodide into tissues already infiltrated with pus and urine is not likely to be productive of any serious sequelæ, if very low (gravity) pressure is used, which is our invariable custom; and the information furnished by the extension of even a trace of this solution beyond the confines of the ureter is of paramount importance.

In our cases the clinical details were essentially in accord with the above generalizations. Pain was conspicuous in the previous history of all three. In one the overwhelming fact of total anuria obscured everything else, though it is to be noted that the patient had fever and a very high blood count. In the other two sepsis was obvious; one of these presented striking local findings, the other did not. Shadows were present in the X-ray plates of all three. In one the diagnosis was disclosed (unexpectedly) at autopsy; in the other two it was established by pyelography.

*Prognosis and Treatment.*—The condition is admittedly grave. When the actual leakage of urine is minimal in amount and the tissue reactions are prompt and efficient localization of the process may be accomplished, with or without the development of a circumscribed abscess; under these circumstances the patient may actually recover without any surgery whatsoever, as happened in one of our cases. On the other hand, leakage may be more extensive or more continuous, tissue reactions may be less effective, organisms may be more virulent; devastating phlegmonous or gangrenous infection

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or septicæmia may then ensue, and the patient may quickly develop a clinical problem of extreme danger and difficulty.

In view of this latter eventuality it must be accepted as a working principle that extravasation of urine, wherever located and from whatever cause, is a frank surgical condition. The imperative immediate indication when the process is early and active is simple but efficient drainage to control infection and save life; the underlying cause of this condition can be approached later or not, according to circumstances. If the patient comes under observation later, and in the meantime has apparently effected localization of the process, surgery may be undertaken with less haste; the situation may then justify some attempt at accuracy of diagnosis and preliminary catheter drainage and other measures may improve the patient to the point where not only drainage of the area of extravasation can be established but the fundamental underlying or consequent pathology can be attacked at the same time, making secondary operation unnecessary. During this period of conservative management the patient must be kept under very close observation and prompt intervention must be substituted upon the slightest indication.

The ultimate operative procedure will depend upon a variety of possible circumstances making generalizations impracticable. Following primary drainage the situation may adjust itself; the calculus may be expelled or may remain quiescent in the tissues, the ureteral fistula may close spontaneously, and the kidney may overcome the infection and resume its function wholly or to a considerable extent. If a fistula persists, or if the continuity of the ureter has been broken, the ideal procedure would be repair but would be difficult, perhaps impossible, in the presence of the infiltration and adhesions resulting from the extravasation. Nephrectomy would then be necessary and would be required also when the kidney has become riddled with infection, as was the case in one of our patients. Finally, if the calculus remains in the ureter, or if other calculi are present in the kidney, an additional problem is introduced. Broadly speaking, therefore, the time and type of surgery will have to be determined in the light of the circumstances existing in the given instance.

### CASE REPORTS

CASE No. I.—A. G., white, male, age sixty-seven, was sent into the hospital anuric in January 1927. For ten years prior to that time he had suffered urinary difficulty from hypertrophy of the prostate, operation for which had been discouraged by two noted urologists. At intervals he had brief spells of acute retention requiring catheterization. Such an attack had occurred about three weeks before he came under our observation. A single catheterization relieved him of this. Urinalysis and blood chemistry at that time were normal.

Five days before he entered the hospital he became quite ill, with chills, fever up to 103°, violent pain in the left renal area, which soon subsided and did not recur, some aching in the right side, and a considerable amount of blood in the urine. Three days later he was unable to void and catheterization showed the bladder to be empty. When seen by us he had been in this anuric condition forty-eight hours. General examination disclosed moderate hypertension, grossly infected and enlarged tonsils, and an enormous

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prostate. The bladder contained no urine. An X-ray plate showed some suggestive but indefinite shadows in the region of the left kidney and along the course of the upper right ureter. Cystoscopy was attempted but was prevented by a massive median lobe barrier.

Heroic measures to relieve toxæmia and stimulate renal activity resulted in nothing. Bilateral nephrotomy was suggested but agreement could not be reached among consultants.

The creatinin advanced to 10.5 milligrams and the patient became comatose and died, three and a half days after he entered the hospital. Anuria persisted to the end. A partial autopsy was permitted. The X-ray shadows were now found to represent urinary calculi; other small sand-like concretions not visible in the plate were also present; both upper ureters were blocked; both pelves were dry; at the uretero-pelvic junction on the left side perforation had occurred through a partially gangrenous patch from stone pressure; from this point suppuration had begun to spread through the perirenal tissue.

CASE No. II.—R. H. B., white, male, age fifty-two, entered hospital in February 1928 with severe pain in the right renal area, radiating downward along the course of the ureter, and with a history of two similar attacks in the course of the preceding five years on the same side, and two others on the opposite side. Upon one occasion he passed a small calculus. The present spell appeared to be the worst in the series and the patient looked quite sick and somewhat septic. His temperature was 101° and his urine was loaded with pus. There had been no striking vesical disturbance, though at times the patient had experienced some difficulty getting his stream started, and his urine occasionally burned him. The remainder of the history was essentially negative with the exception of constipation, flatulence, and some shortness of breath on exertion. Physical examination disclosed only some enlargement of the heart, some disturbance of the cardiac rhythm, and some tenderness and enlargement of the right kidney. The left renal area appeared normal in an X-ray plate; indistinct calcified patches were present in the region of the bladder and of the right kidney.

Cystoscopic exploration revealed moderate gross cystitis and a veil-like floating mass in the bladder accounting for the shadow visible in the röntgenogram; the bulk of this was washed out through the cystoscope. Catheters were passed to both pelves—easily on the left—after overcoming some resistance in the lower ureter on the right. There was a normal drip from the left catheter, with negative urine and a good output of dye; on the right side the urine was under some tension, about fourteen cubic centimetres was aspirated, the specimen was full of pus and the dye output was a bare trace in nineteen minutes. All specimens were surprisingly acid in reaction. A small amount (six cubic centimetres) of iodide solution was allowed to run into the right pelvis but did not fill it though it was sufficient to identify the shadows in this area as thin calcareous material, probably identical with that observed in the bladder.

Catheter drainage of the right pelvis was maintained for two days and was productive of marked relief. Relapse promptly occurred when the catheter was removed and it had to be replaced. Temperature, blood chemistry, and blood counts responded to drainage and regressed when it was stopped. Mercurochrome intravenously, and other lesser measures, were apparently of some additional benefit. As this process could not be kept up indefinitely, however, pyelography was again attempted to determine some better cause of the behavior of the patient and perhaps point the way to some more lasting relief. A larger amount of solution was now run into the pelvis which became fully distended, exhibiting marked distortion and extravasation apparently through the ureter into the tissues opposite the third lumbar vertebra.

The necessity of operative intervention was now quite obvious but as the patient's general condition was poor and as he regularly improved when satisfactory catheter drainage was maintained this was deliberately continued as a preliminary. The right

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catheter, the tip of which was lying in the top calyx, was pulled down somewhat and was retained for some days. Eventually the patient reached a point where, though definitely better, he seemed at a standstill. Operation was performed the same day, and as the kidney had shown no consistent ability to recover its function it was removed. Dense adhesions and peri-ureteral infiltration made the procedure somewhat difficult. The point from which the extravasation occurred was not clearly located. Microscopically the kidney exhibited marked chronic nephritis superimposed upon which was an acute diffuse suppurative nephritis with multiple abscess formation. The wound was troublesome for a time but eventually healed solidly and the patient to-day is in excellent condition locally and generally.

CASE NO. III.—C. C. B., white, male, age thirty-seven, came under observation in December 1928 for persistent disability and continuous decline in health since a brief spell of violent sub-costal and lumbar pain on the right side two weeks previously. Beyond this incident there was no antecedent history of any consequence. Bladder disturbance was conspicuous by its absence. Severe pain was no longer present but there was a dull ache and soreness in the upper right quadrant, where there was also a palpable mass taken to be a grossly enlarged kidney. The urine, previously full of pus and blood, was now practically negative. A preliminary X-ray plate showed a small round shadow opposite the fourth lumbar vertebra on the right side, several smaller shadows in the general direction of the renal substance on the same side; and two minute questionable shadows opposite the third lumbar vertebra on the left side. The patient himself appeared washed out, anæmic and septic and he complained of having lost a great deal of weight.

Cystoscopic exploration disclosed that on the left side the urine, the pyelogram, and the function were normal. A minute shadow was identified as a calculus in the lower calyx. On the right side no urine was coming from the orifice but pressure over the kidney finally brought away a swirl of milky fluid. When a catheter was passed to the pelvic level thick pus was aspirated, followed by a thinner accumulation, and simultaneously there was definite reduction in the palpable mass in the upper abdomen. There was no dye excretion whatsoever from this side. The shadows previously noted were identified as calculi in the ureter and kidney. The pyelogram indicated considerable pathology, but most important of all there was adjacent to it the evidence of considerable extravasation, probably through the upper ureter.

Immediate operation was urged but not accepted. The patient disappeared from sight and was presumed to be dead. Six weeks later he walked into the office and announced that he was now prepared to go ahead with the operation. He was almost unrecognizable. His complexion was ruddy, he had regained a great deal of weight, he was free of pain, his right kidney was still palpable but much reduced in size and his bladder urine was now frankly purulent. A further cystoscopic review showed that the small shadow on the left side had increased markedly in size; there was now a sprinkling of pus cells in this urine, and the functional dye output was well in excess of normal; the pyelogram was essentially normal. On the right side, a calculus was encountered in the lower ureter and was passed after some difficulty; much pus again presented here, but the functional dye output, previously non-existent, was now one-fifth of normal, showing some tendency of the kidney to recover itself. The pyelogram showed startling improvement—not only in the contour of the pelvis but also in the shrinkage and sharp localization of the zone of extravasation; the general kidney outline was also much reduced in size.

A revision, if not a complete reversal, of judgment seemed to have been dictated by unexpected events during the six weeks that had elapsed. Evidently catheterization and drainage at the original exploration opened an outlet for the accumulation in the right side which was still discharging itself into the bladder, relieving the tension on the kidney and ridding the patient of his sepsis. In the meantime the speck-like shadow on



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the left side, which up to now had been treated with contempt, was assuming threatening proportions. With some misgivings, but with the reassurance of the patient's progress and the fact that he was under close observation, a new program was mapped out—namely, the conservative control of the right side, where surgery had previously seemed urgently indicated, and the transfer of the projected operation to the opposite side, when the appropriate time for it seemed to arrive.

Eventually this was accomplished without mishap. Shortly after the second cystoscopic manipulation the patient passed five calculi varying in size from an English pea to a match head. This largely cleared out the right side for the time being; the shadow on the left remained in situ. Systematic treatment was carried out through a considerable interval, consisting of a general process of upbuilding, wide dilatation of both ureters, and lavage of the renal pelves. During this interval the right side steadily improved, while on the left side the stone shadow slowly but steadily grew. A point was finally reached which appeared to represent the maximum of what could be expected. The area of extravasation on the right side was now reduced to a bead-like excrescence upon the upper ureter; urine from this side still contained considerable pus but the dye output was now two-thirds of normal and the kidney, at first supposedly hopeless, seemed actually ready to shoulder a large load of excretion while its mate underwent the tax of operative removal of its growing calculus. The patient himself was clinically well, at his work daily, robust and the possessor of about forty pounds of new weight. At this time the patient gained entrance to a charity hospital where the stone was removed from the left kidney through a small nephrotomy incision, the pelvis being entirely intrarenal. He was out of the hospital in a little over two weeks and at no time was there the slightest threat of any complication incident to embarrassment of the right side. Three weeks after operation his dye output in two hours was 81 per cent. with 45 per cent. in the first thirty-minute period. At the present time he is apparently in perfect health. A recent X-ray plate shows the left side clear; on the right side there remain a few very small shadows which have persisted throughout. One of these seems to lie just outside the ureter and is probably the stone responsible for the extravasation.

### SUMMARY

1. Extravasation from the ureter in the absence of external traumatism is an unusual lesion of grave significance, herewith exhibited in three cases.
2. In all three instances the causative factor apparently was necrosis from impaction of a calculus within the ureter.
3. The clinical picture depends upon the amount of extravasation, the virulence of the associated organisms, and the tissue reactions of the patient. Rapidly spreading infection may result or the process may become localized with or without abscess formation.
4. The fact that one of our cases recovered entirely without operative intervention on the affected side is interesting and suggestive.
5. As a rule, however, the condition will be frankly, perhaps imperatively surgical. The time for the application of this surgery, and the type of operative procedure undertaken, will be dictated by the conditions obtaining in the individual case.



## FRACTURES AT THE CONDYLES OF THE FEMUR\*

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IN THE field of traumatic surgery, fractures about the femoral condyles are engaging our attention with increasing frequency. It was the appearance of three such injuries in our wards at the Roosevelt Hospital in fairly rapid succession, which led to an investigation of these cases. The resulting report is based upon thirty-eight cases of fractures at the femoral condyles discovered in the records of the Roosevelt and Lincoln Hospitals over a period of twenty years and ten years respectively.

In 1921, Speed<sup>1</sup> reported but eight cases of condylar fractures in 526 fractures of the femur seen at the Cook County Hospital in three years. Rabut<sup>10</sup> quotes Malgaignes' report of five fractures in the lower third of the femur in a total of 316 femoral fractures. Ashhurst<sup>8</sup> more recently (1926) reported eleven fractures about the condyles in a total of 111 fractured femurs seen at the Episcopal Hospital in Philadelphia.

The fact that these injuries are occurring now more frequently than they did in the past is evidenced by the fact that of the thirty-eight cases here reported seventeen have been seen in the past five years. The cause of this increasing frequency of femoral condyle injuries may be sought in the record of their etiology. Twenty, or rather more than half of them, resulted from automobile accidents—a commentary on the ever-increasing traffic hazards which are filling our accident wards every day. The incidence of these fractures places them in a class with fractures of the skull, the fractures of the tibial head described by Cotton, and with fractures of the pelvis. Most of them, unlike the typical fractures of the radius, clavicle, humerus and femoral neck, are essentially fractures of direct violence and have no predilection for a special age group. The age incidence in the cases here reported is from thirteen months to sixty-four years—an average age of thirty-two—representing a fair mean of the active years. Men were slightly more often the victims than women—25 to 14.

The histories of these injuries are difficult to elicit from the patients. The mechanism is usually vague and can frequently only be inferred from the discovered pathology. The accident itself is so surrounded in the patient's mind by its essential aura of fright, excitement, confusion and pain that little is remembered of its exact character. In a general sense, however, it is apparent from the survey of the mechanism of injury in these cases that direct violence preponderates as an etiological factor. The one exception—that of epiphyseal separation—is noteworthy.

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\* Read before the New York Surgical Society, May 14, 1930.

Another feature of interest in the general consideration of these fractures about the femoral condyles is the frequency with which other injuries are associated with them. Multiple contusions, abrasions and lacerations are the rule rather than the exception, while fractures in other bones or other parts of the femur were present in four of the cases. Shock, too, is a factor very much to be reckoned with in the early treatment of patients suffering these injuries. Sometimes it is extreme, even though the fracture be not



FIG. 1.—Fracture above the condyles with characteristic posterior displacement.



FIG. 2.—Fracture above the condyles in a child, with anterior displacement.

compounded, and requires treatment before attention can be given to the bone injury itself.

For our consideration, these fractures about the condyles may be conveniently grouped in the following classification:

- Fracture above the condyles,
- Fracture between the condyles,
- Fracture of external condyle,
- Fracture of internal condyle,
- Separation of condylar epiphysis.

## FRACTURES AT THE CONDYLES OF THE FEMUR

*Fracture above the condyles.*—(Figs. 1 and 2.) In reading the textbooks and published articles on these injuries, one is left a little in doubt as to just where fractures of the lower femoral shaft end and supracondylar fractures begin. In selecting from our records those cases which should conform most closely to the true supracondylar (such as Moorhead<sup>2</sup> happily describes as juxta-epiphyseal), I have included only the fractures occurring in the flattened portion of the bone, just above the condyles. There were eighteen injuries of this type in the group. The ages of the victims varied from thirteen months to sixty-four years.

As cause of these fractures, our records show that direct violence was almost universally responsible. Ten were struck by automobiles. Two of these were caught between the car or truck and a wall. In one, the legs were run over by the vehicle, both femora being fractured just above the condyles by the wheels. Whether the others injured by cars received their fractures by the impact or by reason of being thrown violently to the knees is uncertain, but one suspects the latter to have been the case. This seems more probable since the bumper of the average car is rather too low to strike the adult femur, and also because six of the cases not injured by cars were hurt by falls upon the knees (two down steps, one from a window, two while walking, one out of bed). One additional patient struck the knee against a tree while coasting. One only of the entire number received this type of fracture by indirect violence. This patient was an arthritic whose femur was recorded as being fractured during an attempt to mobilize a partially ankylosed knee-joint under anæsthesia.

The pathology produced by these injuries showed some variation. Five showed spiral or oblique fractures running up the shaft. Of these, two were oblique in the antero-posterior plane, the others lateral. One of the latter, in a boy of eight years, was oblique into the epiphyseal line and associated with a lateral epiphyseal separation. One of the antero-posterior oblique fractures had a forward displacement of the distal fragment. Ten of the remaining fractures in this group were of the transverse type. Four showed anterior displacement of the distal fragment; the other six the usual posterior position. Oddly enough, the four transverse supracondylar fractures with the atypical forward displacement were in children eight to eleven years old—the deformity corresponding closely to that seen in complete epiphyseal separations. In the adult cases, the posterior displacement, ascribed by Scudder<sup>3</sup>, Speed<sup>4</sup> and others to the pull of the gastrocnemii, occurred with regularity. One of these transverse fractures was of the greenstick type (Fig. 3), occurring in the youngest patient of the group, a baby of thirteen months. The remaining two were compound and comminuted, with crushing injuries of the soft parts.

Complicating injuries with the supracondylar fractures occurred in two other instances besides those noted above. In one, the tibia and fibula were broken in the injured leg. In another the femoral fracture was compound.

In none of the simple fractures was there evidence of injury to the popliteal vessels or nerves, or to the knee-joint.

The clinical appearance of these patients, when admitted, was strikingly similar. All were in a greater or less degree of shock, with prostration and pain. The leg was characteristically helpless, and any movement was attended with great discomfort. Characteristic deformity was usually masked by swelling which appeared early and was in most instances noted as being "considerable" or "marked." Such deformity, as could be observed, suggested a dislocation of the knee. Active and passive motion were restricted because of pain. Marked and diffuse tenderness of the lower femoral



FIG. 3.—Greenstick fracture above the condyles. FIG. 4.—Fracture between the condyles. "T" type.

region was the rule, and precluded satisfactory objective examination. Shortening of one-half to two inches was observed. The diagnosis was confirmed in each instance by X-ray.

The treatment of the fractures above the condyles was by no means uniform in this group. In seven, satisfactory reduction was secured by manipulation, as recommended by Speed.<sup>1</sup> Manipulation to produce these reductions consisted in manual traction, guiding of the lower fragment and flexion. In one instance, where there was anterior displacement of the fragment, resisting reduction, success was attained by flexing the leg against a fulcrum formed by a sling around the upper calf. In six cases, attempts at reduction by manipulation were unsuccessful, and resort was had to traction by various means. This traction was secured by ice tongs in the

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condyles in three instances, and by Steinman pin through the condyles in three. In all but one of them satisfactory reduction was obtained by these means. No open reduction was performed, although it was proposed and refused by the patient in the unsuccessful tong-traction case. This was an oblique fracture with anterior displacement which would not reduce. A fair result was nevertheless obtained. The infant of thirteen months was treated by overhead traction with the legs extended. Three patients received no treatment for their fractures—two who died from shock shortly after admission and one who went home against advice. One other patient had such a severe crushing injury that amputation was necessary.

The fourteen cases treated in this series of eighteen fractures above the condyles responded, with one exception, to one of the two simple means of treatment employed. In those cases where reduction by manipulation was successful and plaster was employed for immobilization, there was encountered no difficulty resulting from pressure or constriction, which Speed<sup>4</sup> cites in warning against its use. Wilson and Cochrane<sup>5</sup> recommend plaster in these cases, while Cotton<sup>6</sup> and Ashhurst<sup>8</sup> prefer Buck's extension and Speed<sup>4</sup> the Hodgen's or Thomas splint.

In the cases where manipulation was not successful, traction with tongs or pin in the condyles proved satisfactory. Perhaps these patients were fortunate in failing to develop any untoward complication in the use of this method. Wilson and Cochrane<sup>5</sup> object to this procedure because of the danger resulting from the insertion of the traction apparatus so close to the fracture. There has seemed to us, however, a certain advantage in applying traction at the condyles, rather than at the tibial head as suggested by Moorhead<sup>2</sup> or at the calcaneus as Speed<sup>4</sup> recommends, in that the distal fragment may be more accurately controlled. This is a matter of some importance, because of the difficulty in overcoming the backward displacement and rotation of the distal fragment which is so characteristic and frequently so stubborn. In fact, the higher the tongs or pin can be inserted, below the fracture, the better for the purpose of mechanical reduction.

Our experience in handling these cases with traction convinces us of the desirability of a position of the leg in which the hip and knee are both flexed. On this point, most of the authorities consulted seem to agree. To accomplish this, we have found the suspended Thomas splint with Pearson attachment entirely satisfactory. This is employed with direct traction on the condyles, exerted through the tongs, supplemented with light traction on the lower leg through adhesive strips on the skin. This latter force aids materially, it seems, in tilting the distal fragment forward. These pulls may be varied in direction and force to accomplish the desired end.

Following reduction, and a period of retention either in plaster or splint over a period of from six to eight weeks, these patients were allowed up with crutches and were given physiotherapeutic treatment.

As to the results to be expected in fractures above the condyles, Speed<sup>4</sup> is not very optimistic. Pointing out the difficulty of securing and maintaining



reduction and the likelihood of persisting stiffness, he declares the prognosis for full function poor. Cotton<sup>6</sup> calls the prognosis fair, while Ashhurst,<sup>8</sup> reporting six supracondylar fractures in a series of eleven fractures of the lower femur, had one fully satisfactory result.

Of this group of eighteen cases, the results are recorded on the following data:—

Left hospital at own request.....	1
Died within three hours of admission.....	2
Leg amputated for irretrievable crushing injury.....	1
Not seen after discharge .....	5
Result observed by follow-up (six months to ten years).....	9

Of those not seen after discharge, four left the hospital with satisfactory early results; *i.e.*, with union, no deformity, no shortening and returning function. One case had three-quarters inch shortening and slight posterior angulation. What the eventual results may have been in these cases, we have been unable to determine. Of the nine cases followed subsequently to their discharge, for periods varying from six months to ten years, four satisfactory and five poor results were noted at the time of leaving the hospital, while the late results were reported satisfactory in six, and poor in three. The satisfactory results had good union, no deformity, no shortening and good function. Of the poor results, all had one-half inch to three-quarters inch shortening with some limp. All of the five in which a late satisfactory result was reported had been treated by closed reduction and plaster. Of the three poor results, all had been treated with Steinman pin or tongs and traction. The difference here, it seems fair to assume, depends primarily on the original nature of the fracture (as suggested by the treatment required), rather than on the type of treatment.

*Fracture between the condyles.*—Closely allied to the fracture above the condyles, because always accompanied by it, is the fracture between the condyles. In fact, Scudder<sup>3</sup> groups these fractures together in his discussion of them. Yet it seems that they should be classified separately because of one important point of difference. The fracture between the condyles inevitably involves the knee-joint, introducing a difference in pathology, in prognosis and new problems in treatment. Also, fortunately, it is distinctly less frequent in occurrence.

In this group of thirty-eight cases of fractures about the condyles, there were but seven of the intercondylar type. All but one occurred in patients from forty to forty-five years of age. The exception was eighteen.

As in the case of most of the fractures above the condyles, these injuries were produced by direct violence. Our experience here agrees with that of Cotton<sup>6</sup>. Five followed violent falls on the knee; one patient was hit by a truck; while one occurred in an automobile collision.

The pathology, as observed in these cases, was quite similar. All were of the T-type. Six had transverse fractures above the condyles (four with typical backward displacement), and the other a spiral fracture separating

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the condyles from the shaft in addition to the intercondylar injury. No instance of the Y-fracture with wide separation of the condyles was seen. Marked effusion into the knee-joint and hæmarthrosis were present in all.

Complications, too, were relatively common. One patient presented a comminuted fracture of the patella in addition to his femoral injury. In one case, the shaft of the same femur was broken in the middle third, and a fracture of the radius on the same side had been sustained. Two of the others were compound.

In six of the cases, the clinical aspect shortly after injury was typical. Shock, pain and disability were the prominent characteristics. Marked swelling about and above the knee was present, with tenderness and a curious feeling of "looseness" on palpation, with separate mobility of the condyles. The exact nature and extent of the injury was found difficult to estimate without the aid of the X-ray. One case presented a striking difference. This man had fallen on his knee a month before admission and came complaining of stiffness and some pain and lameness in walking. Examination showed some tenderness about the condyles and fluid in the knee-joint. The leg was held somewhat flexed, the motion being much limited. The X-ray demonstrated a T-fracture without displacement.

This patient, in the way of treatment, was kept in bed for a week, had physiotherapy for three weeks, and then, the knee remaining quite fixed in semi-flexion, it was straightened under ether, and a cast applied in the extended position. With the others, it was a different story. One of the compound fracture cases was treated by suspension and skin traction in a Thomas splint for five days. A gas bacillus infection of the wound then occurred, necessitating amputation. Death ensued. The other compound fracture was recorded as being treated with similar traction for three days. No reduction being obtained, traction by a pin in the tibial head was substituted for thirty days. Some improvement of position was obtained but no union. An ambulatory pneumatic splint was then tried with the same result. Then open reduction was done. This was followed by sepsis, amputation and death. Two of the remaining cases, not compounded, were successfully treated with skin traction and subsequent application of plaster in extension. The patient with the complicating mid-third fracture of the femur was treated by traction applied through hooks inserted in a plaster cast which extended from the toes to mid-thigh. A satisfactory reduction and maintenance of both fractures was thus obtained. In one case, where skin traction proved inadequate, direct traction was applied with ice-tongs in the condyles.

It is apparent, even from these few cases, that in this type of fracture, involving the knee-joint, the hazards of infection are particularly great. A compound fracture of this kind must be looked upon as a grave injury. In addition, it would seem unwise to institute any therapeutic measures which might conceivably introduce infection. Hence, aspiration of the knee-joint

has been avoided, although tongs were inserted in one case. Hitzrot<sup>9</sup> stresses this point in speaking of the dangers of using Steinman pin or tongs in the femur in this type of injury. This risk would apply also to open reduction, although Scudder<sup>3</sup> suggests that these fractures are best treated in the adult by direct reposition by operation, especially if after putting the leg "in a position of physiological rest and relaxation," "with or without traction as may seem wise" for six days, the reduction secured is imperfect. Speed,<sup>1</sup> too, suggests open reduction through the knee by splitting the patella and fixing the fragments with nail or screw, although he says that bicondylar fractures are "best treated" by strong, continuous traction in semiflexion. Cotton,<sup>6</sup> on the other hand, recommends reduction under ether, pressure on the condyles and Buck's extension. He says, "I know nothing of the operative treatment of these cases." "One would rather not operate if operation could be avoided with fair prospects." In the uncomplicated cases, such as three in the group here reported, treatment by skin traction with subsequent application of plaster with the knee in the extended position has sufficed. In the presence of stubborn posterior displacement of the fragments, traction on a pin through the upper tibia, as recommended by Wilson and Cochrane<sup>5</sup>, might be resorted to. In all of these measures, the pull on the lateral ligaments of the knee is depended upon to approximate the separated condyles, aided, perhaps, by direct lateral pressure on the condyles themselves.

In the cases here considered, the plaster was left on, following reduction by traction, for periods varying from three to six weeks. Massage, active and passive motion were then begun. While recognizing the advantages of early motion, there was a distinct disinclination to jeopardize the union before it was solid. The use of Thomas splint and Pearson attachment would no doubt permit earlier motion at the knee with less risk of malunion.

Three of the five cases reported here could not be traced, although at the time of discharge they were noted as having satisfactory union with returning function. The third case (the one in whom the fracture presented minor signs) reported a good result, as might as been expected, at follow-up. The case with double fracture had some limp and one-half inch shortening.

*Fracture of internal condyle* (Fig. 5).—This fracture occurred three times in the thirty-eight cases here reported. Although it, too, involves the knee-joint directly and may, as Wilson and Cochrane<sup>5</sup> point out, interfere with the subsequent function by reason of displacement of part of the joint surface, it is in no respect as severe an injury as the discondylar break.

Speed<sup>4</sup> observes that these injuries may come from direct violence—crushing—or from indirect, by upward thrust of the tibia, as in falls on the feet from a height, or from twists. Cotton<sup>6</sup> suggests forced adduction or abduction as the cause. In one of our cases, the nature of the trauma was not recorded. Both of the others fell downstairs, one with a beer-barrel which rolled over his leg. Thus one may have been due to a twist or to direct violence, while the other was almost certainly direct.

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All three fractures occurred in patients of middle age.

The pathology of these cases, as demonstrated by X-ray, varied but little. Two were longitudinal in character, separating the inner condyle from its fellow and from the shaft with slight upward displacement. The other was oblique, through the inner condyle, the distal fragment being rotated backward, pretty effectually locking the knee-joint. This latter was the one produced by direct violence.

This particular patient had not recovered sufficiently from his encounter with the beer-barrel to appear at the hospital until four weeks later. At that time, he had a very stiff and swollen knee which was tender on its inner aspect and practically immobile in semiflexion. The others presented on admission painful and swollen knees with localized tenderness over the

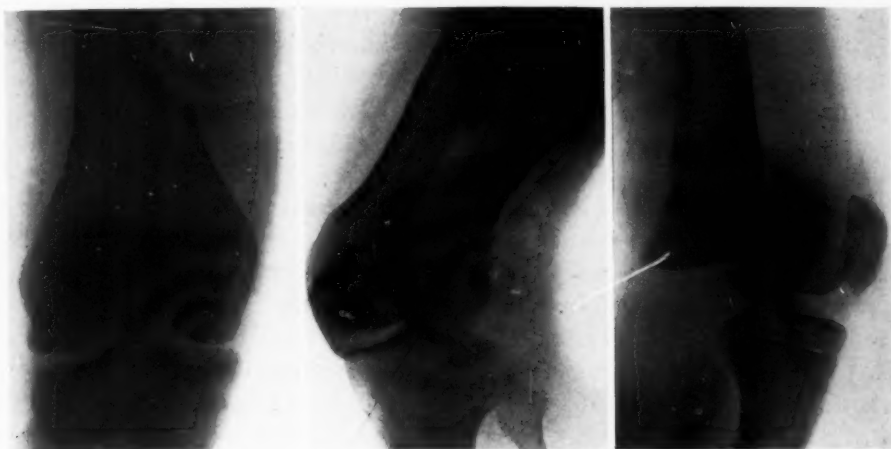


FIG. 5.—Fracture of internal condyle.

FIG. 6.—Fracture of external condyle.

FIG. 7.—Separation of condylar epiphysis.

injured condyle, signs of fluid in the joint, false motion of the fragment and restriction of function by pain.

Treatment in each instance consisted of reduction under full anaesthesia with replacement of the fragment in its proper position by restoring the axis of the leg and pressure on the fragment, as Cotton<sup>6</sup> advises. The legs were immobilized in plaster for from four to six weeks. No open reduction or nailing of fragments was necessary (few cases require it, according to Speed<sup>4</sup>), nor were any of the fragments removed.

Satisfactory progress was noted on these three cases at the time of discharge. Unfortunately, none of them could be traced at recall.

*Fracture of external condyle* (Fig. 6).—Five fractures of the external condyle were found on our records, showing a slightly greater relative frequency than those of the internal. As in the former group, all these were in adults, from twenty-four to forty-five years of age.

All but one were apparently produced by direct violence. Two patients

fell on the knees. One struck his knee against a curbstone. One had a heavy block of stone fall on the knee. The one in which the nature of the trauma was uncertain was struck by an automobile.

This latter patient had a chip fracture of the epicondyle. Two of the others showed longitudinal and two oblique fracture of the condyle, all involving the knee-joint. All showed a greater or less degree of upward displacement and slight backward tilting of the fragment on X-ray examination.

The picture presented by these patients closely resembled that shown by those suffering from internal condyle fractures, in so far as disability, pain, swelling and fluid in the knee-joint were concerned. The tenderness was most marked over the external condyle. In two, a definite genu valgus was observed. One patient, in spite of slight displacement of the fragment, had been able to walk home following his injury.

The chip fracture case required only immobilization in plaster for one week. One case, with some displacement, left the hospital soon after admission and was lost track of. The other one in which displacement was present was given skin traction for two weeks. Reduction being unsatisfactory, tongs were applied and left in place for three and one-half weeks longer—a questionable procedure. Good reduction and union, however, were obtained. The two cases showing little or no displacement were merely kept in bed for four weeks. This, where the conditions warrant, is an ideal treatment. It obviates displacement from weight-bearing during the period of union, and, owing to the freedom of the knee, promotes early restoration of function. In one of these cases, aspiration of the knee was done without ill effect.

Both of these cases obtained satisfactory late results, as did the chip fracture case. The patient with displacement was discharged from the hospital at ten weeks with good union, no deformity and motion 50 per cent. restored.

*Separation of condylar epiphysis* (Fig. 7).—Epiphyseal separation of the femoral condyles, the apparent response of the juvenile to trauma which, in the adult, may cause condylar or supracondylar fracture, occurred in the group here reported five times. All instances occurred in children of five to eleven years of age.

The accident to which these injuries are classically ascribed—severe twisting of the leg, as when caught in the spokes of a revolving wheel—accounted for two of the group. Cotton<sup>6</sup> says that this injury is usually caused by strong hyperextension, the posterior ligament pulling free the epiphysis. Two of these separations were caused by the patients being struck by automobiles. The fifth was produced by a car running over the leg, fairly definite evidence that direct injury may be the cause in some cases. Speed<sup>4</sup> verifies this in his observation that a direct blow on the lower thigh or knee may be responsible.

The typical displacement of the distal fragment forward was observed in all of these cases but one. In this instance (one of the injuries produced



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by twisting), the displacement was outward, the diaphysis having torn and penetrated the vastus externus. The patient run over by a car had some lateral as well as anterior displacement. No complicating injuries of moment were observed in any of these patients, except one, where paralysis of the external popliteal nerve occurred.

Shock was not a marked feature of these cases. The injured legs showed the characteristic deformity with anterior bowing above the knee and obliteration of the popliteal space. The case with laterally displaced epiphysis strongly suggested dislocation by its appearance. In all there was tenderness above the knee, but no evidence of fluid in the joint. Motion in the knee-joint was not greatly restricted. False motion at the site of injury could be elicited in but one instance. The diagnoses, while confirmed by X-ray, were not especially difficult to differentiate from dislocation, because of the unaltered relations of the structures comprising the knee-joint.

Treatment of these cases presented some difficulties. The usual method of reduction, traction upon the leg with the knee bent and manipulation of the distal fragment, under anaesthesia, was attempted in all. It was fully successful in but two of the five injuries. These, following reduction, were maintained in flexion by plaster dressings. In one of these, subsequent straightenings of the knee under ether were necessary to overcome fixed flexion. Of the unsuccessful reductions, one slipped, when, at the end of four weeks, extension was permitted, requiring a second manipulation and subsequent immobilization in extension. The case with lateral displacement could not be reduced by the closed method, and open replacement was resorted to. The same was true of the fifth case. Here the always dreaded infection supervened, producing a septic arthritis of the knee and eventual ankylosis.

The experience in the treatment of the cases of epiphyseal separation here recorded, therefore, has led us to consider these injuries with some trepidation. The reduction is by no means always as simple as it looks, and when once achieved may be difficult to maintain. Open reduction, possibly with fixation either from the shaft or joint side by nailing, as suggested by Speed<sup>4</sup> in the difficult cases, seems hazardous. The sling-fulcrum manœuvre, successful in one of our cases where manual reduction had failed, might prove helpful, or traction with Thomas splint and turnbuckle applied at the ankle. One might almost be tempted to try slower weight traction with a pin low in the tibial head before resorting to operation. We have had no experience with the latter method.

The results obtained in the five cases here considered were hardly brilliant. One, as indicated, had a permanently stiff knee. The other patient, upon whom open reduction was done, secured a perfect result. So also did the two cases in whom successful closed reductions were performed—one of them in spite of early external popliteal nerve paralysis. The remaining patient left the hospital with cast still applied, and no follow-up

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record is available. Thus three satisfactory results out of five cases is the score for this group of epiphyseal separations.

## SUMMARY

	Number	A. O. R.	Result			
			Early Only		Late	
			Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory
Above condyles.....	18	1	4	4	6	3
Between condyles.....	7	—	2	3	1	1
Internal condyle.....	3	—	3	—	—	—
External condyle.....	5	1	1	—	3	—
Separation of epiphysis...	5	—	—	1	3	1
Total.....	38	2	10	8*	13	5

\* Including deaths and amputations.

The study of this group of fractures about the condyles has demonstrated to us certain salient features concerning them. We are reminded afresh of the seriousness of this type of injury, not only as regards its menace to future usefulness of the limb, but even to the life of the patient. One has been impressed with the difficulty which proper reduction and maintenance of the fragments entail. Also, it is apparent that, even in each of the several classes of fracture here met with, there is no one method applicable to their treatment. Certain general principles being accepted, each fracture presents a unique problem of its own upon which the surgeon must bring to bear his judgment and ingenuity. One cannot but be impressed, too, with the gravity of infection in these cases and, because of this danger (particularly where the knee-joint is involved), prefer to attempt every available means of securing reduction before resorting to operation. The results obtained leave much to be desired, and invite, therefore, further investigation of these injuries with a view to improvement in their management.

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## **FRACTURE OF THE SHAFT OF BOTH BONES OF THE LEG\***

**AN ANALYSIS OF 107 CASES**

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**FROM THE SURGICAL SERVICE OF THE BEEKMAN STREET HOSPITAL**

LITTLE has been published in the past few years regarding the treatment and result in fractures of both bones of the leg, not involving the joints. I am offering nothing new in the way of treatment, but wish to bring for consideration one hundred fourteen consecutive cases treated by the staff of the Beekman Street Hospital during the six-year period from 1924 to 1929, inclusive. This hospital is located in the downtown district of New York City, which is a section of high buildings, incessant new construction and intense traffic congestion. In our ambulance district there is said to be a resident population of only thirty thousand people and a working population of seven hundred fifty thousand. This explains the age and sex groups and the type of fracture which appear in this analysis. We have not insisted on any one method of treatment, but are partial to traction suspension treatment by means of the Steinman pin through the os calcis in cases of overriding. There are still many horses present in the district where we work, hence gas bacillus infection is prevalent and we do not feel justified in open operation as a routine procedure. Also, we believe that traction suspension gives satisfactory results, is less dangerous, and causes no particular lengthening of the period of the patient's disability. Many of our cases are compounded and such treatment is more rational in these than immediate application of plates or screws, as is frequently recommended.

The treatment given the patient immediately after the fracture occurs is the all-important one. Our ambulance surgeons are instructed to apply a Thomas splint to all these patients where they lie, whether on the street or in a building. The clothing is not removed, but cut when necessary for the dressing of wounds and tentative diagnosis. Traction is obtained by a hitch about the ankle. Morphine is administered as a routine. All fractures are emergency cases about which the visiting surgeon must be immediately consulted. In the emergency room, traction is removed only long enough to determine the site to be X-rayed and then is immediately reapplied. Examination for crepitus and false point of motion is made only when necessary to determine the part to be X-rayed. In compound fractures, tetanus antitoxin is given in the emergency room. The presence of shock is decided by the resident surgeon, and, if present, its treatment is commenced here. If the patient's condition warrants, he is next taken to the X-ray room for a picture. He then goes to the ward, where removal of his clothes is supervised so that

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\* Read before the New York Surgical Society, October 22, 1930.

manual traction on the extremity will be maintained if the hitch has to be loosened. The emergency traction is inspected at least every half hour to guard against circulatory embarrassment, and this traction remains on until the final treatment has been decided upon, after inspection of the X-rays.

Compound fractures are thoroughly scrubbed, irrigated and débrided as soon as the patient's condition warrants anaesthesia. Anaesthesia is used for practically all manual reductions. Steinman pins are inserted in the ward if it is felt that the patient's condition is such that he should not be removed to the operating room.

To summarize, we find that fracture of the shaft of the long bones is frequently a shocking injury. This shock is combated by morphine and care against submitting the patient to further movement of the fragments, pain, *etc.* Also, putting the muscles at rest by immediate traction does more to facilitate proper reduction than any other single procedure.

If there seems to be any likelihood that a manual reduction can be obtained and maintained, this is always attempted first. Plaster splints are then applied. Circular supports are not allowed in early treatment, but we use posterior and lateral sugar-tong splints of molded plaster extending from mid-thigh to toes with the knee in slight flexion and the foot at right angles and somewhat inverted. The fluoroscope is used during reduction as occasion demands. In the markedly oblique fractures or in those in which overriding is present after attempted manual reduction, the Steinman pin is inserted through the middle of the os calcis. The solid type of pin is used. Fifteen pounds of traction are ordinarily applied for a few hours and reduced to ten pounds when the proper length has been obtained. Skin traction may be effective in fractures of the upper third, but we have not been satisfied with it in the lower two-thirds, as more weight is required than the area of available skin will tolerate for pull. Ice tongs in the malleoli have been used in some cases, but for some time past we have discarded them as they were prone to penetrate too far or to slip.

Open operation is reserved for those patients in whom satisfactory reduction cannot be obtained by the above methods or when it is believed that there is tissue between the fragments.

As Gilcreest<sup>1</sup> says, every effort should be made toward obtaining the normal axis of the leg, *i.e.*, the longitudinal axis of the main fragments of the tibia must be parallel, but some lateral displacement will not interfere with perfect function. A line drawn through the centre of the long axis of the shaft of the tibia should also bisect at right angles a line through the horizontal axis of the astragalus.

For purposes of analysis, I have divided these cases into four groups, *viz.*, spiral fractures, fractures of the upper third, the middle third, and the lower third.

**SPIRAL FRACTURES.**—These most commonly involve the tibia in its distal half and the fibula in its proximal half.

## FRACTURES OF LEG

In this group there were twelve male patients and one female patient. Seventy-seven per cent. were between thirty and fifty years of age.

All of these injuries were by indirect torsion violence, except possibly in the case of one man who claimed that while he was drunk he was kicked in the leg. The typical histories were: "Fell while climbing a ladder and leg caught between rungs"; "Fell ten feet, landing on feet"; "Leg caught between two plates of plow"; "Caught between gang-plank and hand truck and thrown to ground."

Eleven were simple and two were compound fractures. The two compound fractures were apparently compounded from within, *i.e.*, a small punctured wound was present over a sharp fragment. The wound was irrigated but no débridement was done. Four were comminuted fractures, all in the

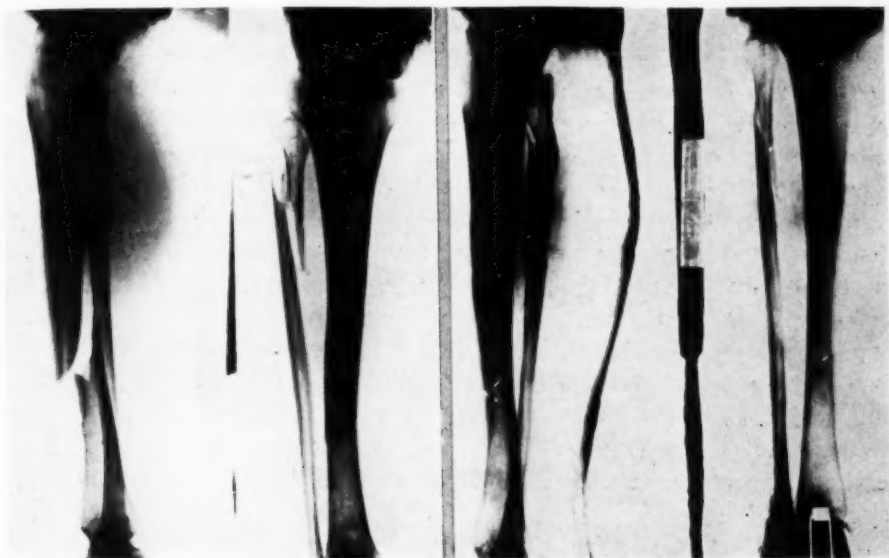


FIG. 1.—Case No. 6064. Spiral fracture before and after reduction. Treated in plaster splints.

fibula only. Two were complicated by other injuries which prolonged the patients' stay in the hospital. No. 3921 A was a fracture of the os calcis, with operation and post-operative infection. No. 4649 was kept in the hospital on account of an eye lesion which required enucleation.

*Treatment.*—In three patients the position was such that posterior and sugar-tong molded plaster splints were applied without any manual reduction. In three others manipulation was done without anæsthesia and plaster was applied. Four were reduced under general anæsthesia and plaster was applied. One had traction by Steinman pin and two had traction by ice tongs as their first treatment. In three of the reductions there was later slipping of the fragments, one patient having tongs inserted in the malleoli on the third day, one having an open operation with Lane plating on the tenth day and one having a Steinman pin inserted through the os calcis on the



twentieth day. That is, out of seven cases in which manual reduction was necessary and attempted, three were unsuccessful. The three cases in which ice tongs were used were in January, 1927, or before. At present the Steinman pin is being used for such cases. In the three unsuccessful reductions, anaesthesia had been used once and none twice. In each case the X-ray showed that the fragments had slipped. To summarize, out of ten cases that required any manipulation, six had to have either traction suspension or open operation. It is a question whether simple application of plaster is not a waste of time in these cases.

The ice tongs or pin were removed at periods from twenty-six to fifty-five days after injury with an average of thirty-nine days. On removal of ice tongs or Steinman pin, adhesive plaster traction suspension was instituted in one case, and in the other four, plaster splints were applied. In one patient the tongs slipped and were removed on the twenty-ninth day when it was felt that there was sufficient callus to hold the fragments in position. The leg was left in suspension without traction and on the forty-first day union was clinically firm and the patient was allowed up in a chair. Definite separation of the tibial fragments then appeared and increased progressively so that on the fifty-fifth day an open operation was done and fascia was removed from between the bone ends. Only fair opposition could be obtained and two kangaroo-tendon sutures were placed through the bone. Union was solid at twenty-six weeks. I believe this patient suffered from insufficient immobilization in all the methods of treatment tried.

In those cases in which tongs or a pin were used, ten pounds' traction were sufficient for those who had this method instituted immediately, and fifteen, later reduced to ten, on those on whom it was applied after the first twenty-four hours. There was no difficulty about the healing of the wounds in any case. There was but one child in this group, nine years old, treated in plaster splints.

We know that all these patients obtained solid union, although we do not know the exact time in all. It is often mentioned in the X-ray report that callus might have been demonstrated if the leg had not been in plaster splints. The presence of callus was not mentioned in one case. It was mentioned for the first time as being present in six cases at a period varying from twenty-five to ninety-one days with an average of forty-nine days and without one long case, forty-one days. On the last X-ray taken while in the hospital, it was mentioned that there was no callus present in six cases. These varied from twenty-six to seventy-five days with an average of forty days, or without the one delayed case an average of thirty-four days. In other words, callus seems to appear most commonly in the sixth or seventh week. The patient who showed no callus at seventy-five days had solid union at ninety days, the false point of motion being only slight at forty-five days. On the other hand, the patient showing callus at twenty-five days had to be operated upon at fifty-five days and fascia was found between bone fragments.

The presence of firm union was mentioned in the notes of nine patients.

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By firm union we mean that considerable effort is necessary to obtain a false point of motion in any direction. The time varied from twenty-six to ninety-eight days with an average of fifty days. Solid union was mentioned seven times, occurring at periods varying from fifty-six to one hundred fifty-four days, an average of eighty-four days. One patient was discharged at one hundred fifty-four days with a false point of motion still present, even though he had shown firm union at fifty-six days. He was treated in plaster splints and obtained solid union ultimately.

The cases on whom skeletal traction was used were the more difficult ones. Here the average time for firm union was fifty-nine days and for solid union ninety days. This included the unsuccessful case of a patient who later had an open operation for removal of fascia from between the fragments. He had solid union five and one-half months after injury. Omitting this case from the summary, solid union was obtained in the patients treated only with plaster in an average of seventy-five days and in those with skeletal traction in sixty-nine days. At least, there is no evidence that skeletal traction prolonged the period of disability.

In recording our results I have used the Massachusetts General Hospital method of rating.<sup>2</sup> The letters A, E, and F signify anatomic result, economic result and functional result, respectively. The figures 1, 2, 3 and 4 after each letter give the percentage value to the final estimation, allowing a range of twenty-five per cent. for each figure, *i.e.*, 1—25 per cent., 2—50 per cent., 3—75 per cent., and 4—100 per cent. Various factors are concerned in arriving at each figure. These are fully described in the above reference. The economic and functional results are estimated after one year.

Six had practically perfect anatomical reduction. Five more had slight angulation or dishing but would come under the Massachusetts General Hospital rating of A<sup>4</sup>. Of the other two, one is A<sup>3</sup> and one A<sup>2</sup>, both F<sup>4</sup>.

No. 4676, A<sup>3</sup>.—Dishing of 10 per cent. with overriding of less than one-half inch after late open operation with insertion of two kangaroo-tendon sutures.

No. 6412, A<sup>2</sup>.—One-inch shortening. Upper fragment of tibia displaced medially, almost full diameter of bone. Function normal.

In only three was there appreciable shortening, *viz.*, less than three-eighths inch, one-half inch, one inch as end-result. The first of these was treated by Steinman pin and the last two by tongs, which slipped in each case.

Of the thirteen patients we have obtained the late result at one year or more in five cases. According to the Massachusetts General Hospital rating, three of these were A<sup>4</sup>, E<sup>4</sup>, F<sup>4</sup>, *i.e.*, the best possible result anatomically, economically and functionally. One patient had A<sup>4</sup>, F<sup>4</sup> at one year, but was intensely neurotic and would not return to work and must be given E<sup>0</sup>. The last of these five patients had A<sup>3</sup>, E<sup>4</sup>, F<sup>4</sup>. He had shortening of less than one-half inch and an angulation of ten degrees at site of fracture. The only datum I have been able to obtain on one other patient is that he returned to his accustomed work in five months.

The three patients who were A<sup>4</sup>, E<sup>4</sup>, F<sup>4</sup> were respectively a compound fracture treated in plaster splints, an open reduction with Lane plating, and a Steinman pin case. The A<sup>3</sup>, E<sup>4</sup>, F<sup>4</sup> patient was treated by ice tongs with a later open reduction for interposed fascia. The A<sup>4</sup>, E<sup>0</sup>, F<sup>4</sup> patient was treated by Steinman pin and the patient who returned to work at five months by ice tongs.

Rixford<sup>3</sup> believes that spiral fractures should have an open operation. He states that results by reduction and fixation or by traction are unsatisfactory anatomically and functionally, that non-union is frequent, and that, in case of union, irregularity of the bone is the rule with persistence of lateral rotation of the leg in the majority of cases and with frequent anterior flexion deformity and more or less shortening. This has not been our experience. We believe open operation is an acceptable method of treatment in proper surroundings and in suitable hands. At Beekman Street Hospital, where there are many dirty cases and where the district is prone to contaminations causing gas bacillus infections, the routine use of traction is much safer. We believe that our late results compare favorably with results by open operation. Neither can we subscribe to the ideas of those who believe that moderate shortening can be disregarded as long as the fragments are in the proper axis. Traction will overcome this shortening and not add appreciably to the hazards. If there is any overriding, it is questionable whether any reduction should be attempted before traction is instituted.

UPPER THIRD.—There were nine patients in this group, seven male and two female. None was under fifteen years of age, six were between the ages of sixteen and forty, and three were over fifty.

Six had simple fractures and three compound. Fractures in this area seem to be characterized by frequent comminution, as there were seven in this series. Three were apparently caused by direct and six by indirect violence, but this may not be correct as six were automobile accidents and the patient's story of the mechanism of injury may not have been accurate. All the compound fractures were by direct violence, *i.e.*, compounded from the outside.

Three cases were complicated by other injuries, none of which necessitated the prolongation of their stay in the hospital.

No. 5305 had a fracture of the twelfth dorsal vertebra and the second lumbar vertebra.

No. 5991 sustained a dislocation of the shoulder.

No. 12474 had concussion of the brain.

*Treatment.*—In only one patient was an attempt at manual reduction made. This was simply a molding of fragments without anæsthesia. Five patients had posterior and lateral molded plaster splints applied with satisfactory position in all. The Steinman pin through the os calcis was used on three patients, in two because of greater ease in dressing severe compound fractures, and in one, with very marked comminution, in an attempt to improve the position of the fragments. This last patient was suffering from cerebrospinal syphilis and became so irrational that he was transferred to Bellevue

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Hospital on the twenty-fifth day, the traction being removed and the leg encased in posterior and lateral molded plaster splints. Of the other two, one had a disarticulation through the knee-joint on the fourteenth day for gangrene following posterior tibial embolism. The remaining patient had the pin in until the seventy-second day, when adhesive plaster traction was substituted and continued until the one-hundred-twenty-first day. One patient had adhesive plaster traction for thirty-five days and the leg was then placed in plaster splints.

Presence of callus was not mentioned in two cases and one patient had an

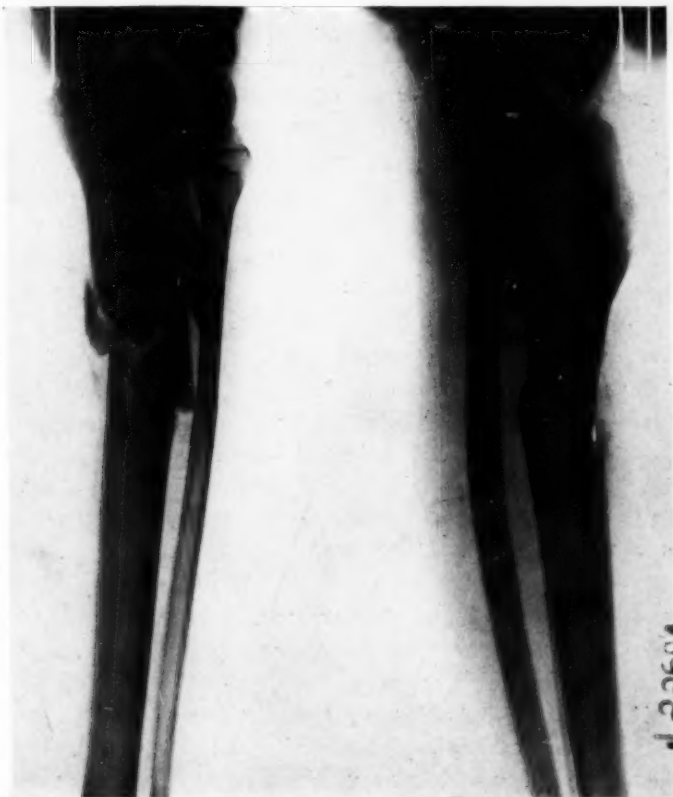


FIG. 2.—Case No. 10034. Marked comminution of tibia in fracture of both bones, upper third. Thirty-five days after injury this shows considerable callus.

amputation on the fourteenth day. In three the X-ray reports mentioned that there was no callus present at twenty, twenty-five and fifty days. One picture showed a fair amount of callus at eighty days but there had been no picture taken since the twentieth day; another showed considerable callus at sixty days, but no picture had been taken since the second day. A boy of sixteen showed considerable callus on the thirty-fifth day. No conclusion as to the average time of callus formation can be drawn from such a small series.

The time of expected union cannot be determined from this series. Two patients had to be transferred to another hospital before sufficient time had elapsed for evidence of union. One patient had an amputation on the fourteenth day. In one case union is not mentioned, but the patient was bearing weight in plaster splints at forty-six days. In four cases union is mentioned as fairly firm in twenty-two, thirty-two, thirty-five and one hundred seventeen days. Solid union was obtained in forty-five, sixty-three, eighty, ninety, and one hundred ninety-six days, respectively. Omitting the delayed case, the average period before solid union was seventy days. The patient who had solid union in forty-five days was sixteen years old. The delayed case presented many complications—a man, aged sixty-six, with a severe compound comminuted fracture requiring extensive débridement of skin and muscles. Gas bacillus infection appeared on the fourth day. The area was incised widely and tetanus perfringens serum given. The patient was in bad condition for ten days, sloughing away a great deal of tissue. On the sixteenth day sugar appeared in the urine and was not gotten completely under control for three weeks, by which time the wound was covered with clean granulations. Up to the sixty-third day there was exposed bone in the wound. The wound then was covered by granulation and on the sixty-fourth day Thiersch grafts were applied to the large open area. All grafts were successful. Traction, as said before, was continued up to the one-hundred-twenty-first day, when splints were applied and the patient was allowed up in a chair. He was discharged from the hospital after seven and one-half months, walking with a cane. He had solid union. A small granulating area was present with evidently low-grade bone infection beneath. At thirteen months two small sequestra came away and the wound promptly healed. At fifteen months the patient showed some modification of gait and a slight deformity.

*Complications.—Gas bacillus infection, one.*

*Amputation for posterior tibial embolus, one.*

*Nerve injury, two.*

The patient with fracture of two vertebræ showed nerve injury causing loss of power of flexion and extension of foot on the side of the leg fracture, hypæsthesia and loss of muscle tendon sense in the toes. At fifteen and one-half months he showed slight weakness in dorsiflexion at ankle only. He remained in the hospital eight and one-half months. One patient showed signs suggesting peroneal nerve injury at four weeks, but was entirely normal at discharge on the eighty-second day.

*Psychosis, one.*

*Delirium tremens, one.*

*Late result.*—We do not know the final result in the two cases transferred to other hospitals. One patient had an amputation. All the others obtained solid union. One patient had A<sup>2</sup>, F<sup>3</sup> (nerve injury involving foot) at fifteen and one-half months, but E<sup>0</sup> being still under treatment for two fractured vertebræ.



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No. 5305, A<sup>2</sup>.—Angulation of thirty degrees at a level two inches below knee, so that shaft below is displaced medially. Treated in plaster splints.

One patient had A<sup>4</sup>, F<sup>4</sup> at fifteen months but had not returned to work. He had been confined to the hospital for seven and one-half months and inasmuch as he was sixty-seven years old when last seen and had been a laborer he probably did not return to work. The sixteen-year-old boy returned to his customary work at three months, A<sup>4</sup>, E<sup>4</sup>, F<sup>4</sup>. The result after one year we do not know in the remaining cases.

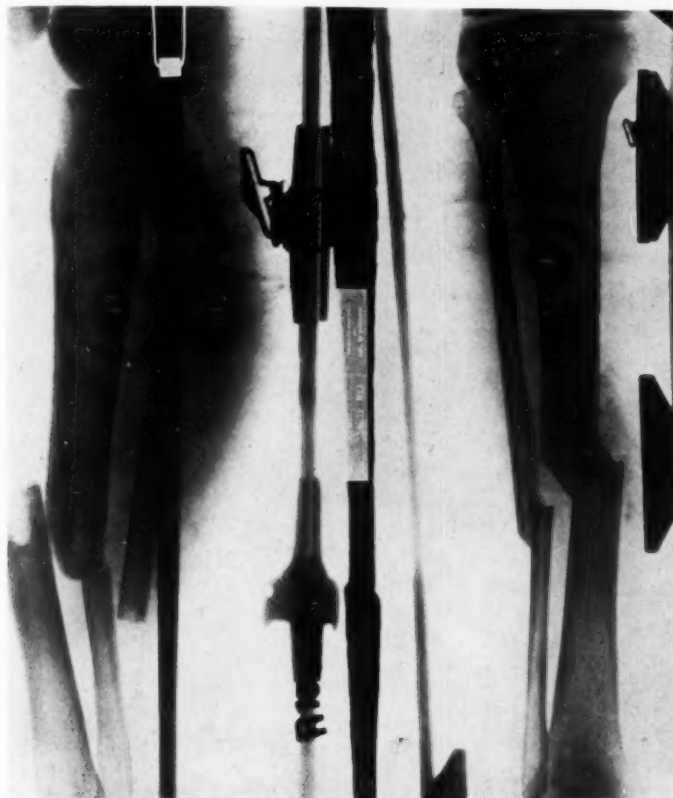


FIG. 3.—Case No. 6398. Compound fracture of both bones, middle third, with overriding. In insufficient temporary traction.

Apparently, one does not need to concern oneself about non-union in fractures of the upper third, but the incidence of complications is large in our series. Simple immobilization in plaster splints seems satisfactory except in complicated cases where traction suspension is valuable.

MIDDLE THIRD.—In this group there were thirty-five patients, of whom thirty-four were male and one female. Their ages were as follows: 0 to 15 years, 3; 16 to 29 years, 12; 30 to 39 years, 7; 40 to 49 years, 5; 50 to 59 years, 8.

Twenty-four were simple and eleven were compound fractures. Five were apparently compounded from within and six from without. Twenty-two,

or almost two-thirds of the group, were comminuted. Twenty-five were apparently injuries by direct and ten by indirect violence. Eleven were caused by automobile accidents, ten by being struck on the leg by a heavy object and four by falls from a height.

Four patients had other injuries.

No. 3528 had a fracture of both bones of the upper third of the forearm.

No. 8098 had a fracture of the shaft of the femur, middle third, comminuted.

No. 11063 sustained a fracture of the femur, the fifth metatarsal bone, the middle phalanx of the fifth toe, dislocation of the phalanges of the fifth toe and the distal phalanx of the big toe.

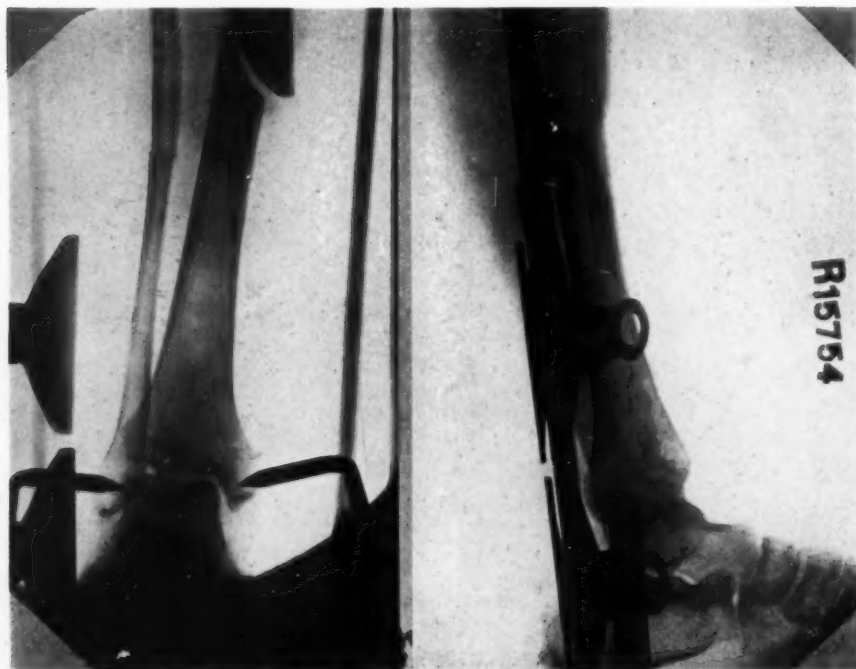


FIG. 3A.—Case No. 6398. At three weeks with tongs in position. Shows callus commencing on tibia.

No. 11399 had a fracture of the shaft of the lower third of the ulna.

The length of stay in the hospital was prolonged by these other injuries in two cases, both fractured femurs, but was not affected in the other two.

*Treatment.*—Of the thirty-five patients, nineteen were treated by immobilization in posterior and lateral molded plaster splints. In eight patients an anæsthetic was given and a manual reduction done before the application of plaster splints. The fragments slipped in three of these, two of whom had tongs inserted in the malleoli on the fourth and sixteenth days, respectively, and one had a Steinman pin inserted in the os calcis on the ninth day.

One patient was treated in adhesive plaster traction, but not from choice. He had a large wound of the heel which prevented the use of a Steinman pin

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and close enough to the malleoli so that we did not care to insert tongs. He also had a fractured femur on the same side treated by ice tongs.

In two cases tongs were inserted in the malleoli as the primary treatment. In one of these, the tongs were removed on the thirtieth day when union was commencing. In the other they slipped on the sixth day and were reinserted. They slipped again on the forty-first day and adhesive plaster traction was substituted. Tongs were also used in two other cases mentioned above, after immobilization in plaster had been unsuccessful. In one of these the tongs slipped five days after insertion and a Steinman pin through the os calcis was substituted. In the other the tongs slipped six days after insertion and plaster traction was substituted, followed ten days later by Steinman pin

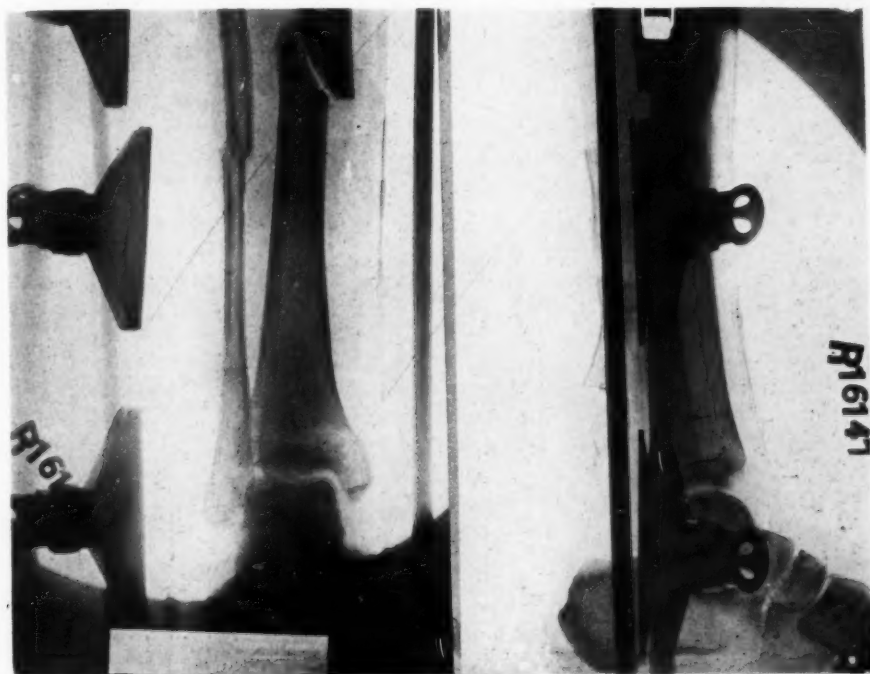


FIG. 3B.—Case No. 6398. At eight weeks in adhesive plaster traction. No overriding, good alignment. Fair callus on tibia.

because of overriding of fragments. In other words, tongs were inserted five times and slipped four times.

Insertion of a Steinman pin through the os calcis was used as the primary treatment in ten cases, after plaster had been unsuccessful in one case and after tongs had slipped in two cases, a total of thirteen patients. Fifteen pounds' traction were usually applied in the primary cases and reduced to ten in from seven to ten days. In the secondary cases the first weight put on varied from twenty to thirty pounds. The Steinman pin remained in for periods from thirty to ninety-four days with an average of fifty-six days. This is longer than is usually advised, but there seems to be little difficulty

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in the healing of the wounds produced by the pins and change of position may occur by removing the pin before union is firm, *e.g.*, overriding, dishing, and angulation. On removal of the pin two patients had adhesive plaster traction suspension applied and the remainder plaster splints. Traction suspension was used on three other patients, but they were transferred too early to know the value of the treatment. The position was good on transfer. Of the sixteen patients treated by traction suspension, nine were simple fractures and seven compound. Four patients had an extensive débridement done on admission to the hospital.

*Callus.*—The presence of callus was not mentioned in five cases. It was

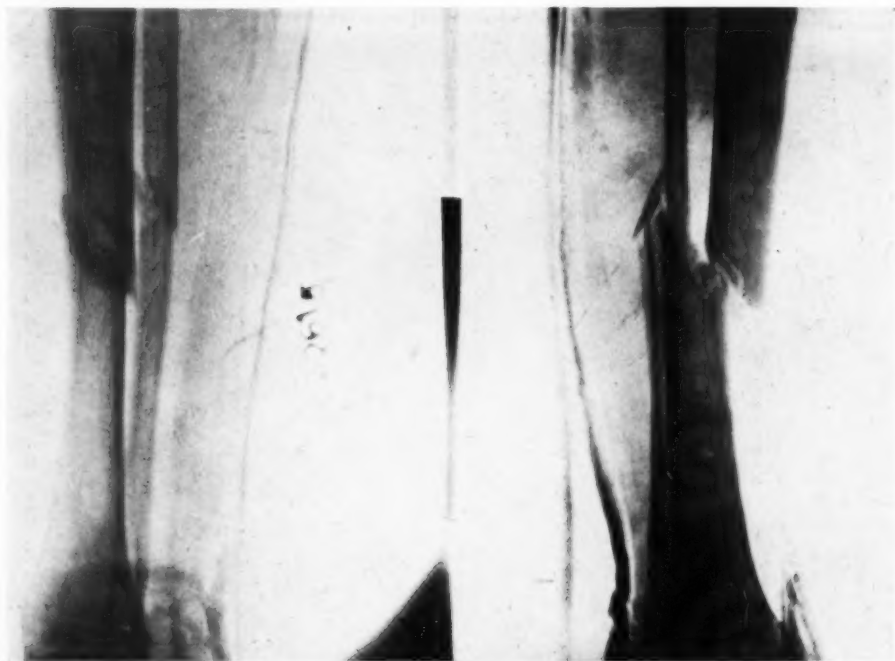


FIG. 4.—Case No. 10145. Fracture of both bones, middle third. Reduced and plaster splints applied. At six days showed slipping of fragments as above.

noted in the X-ray report for the first time as being present in twenty-four cases at a period varying from sixteen to eighty-six days with an average time of thirty-eight days. Omitting the three children, the average time that the first appearance of callus is mentioned is forty days. Again omitting two cases in which it appeared late, eighty and eighty-six days, the average becomes thirty-six days. The earliest appearance of callus in an adult was twenty-one days. On the last X-ray report while in hospital it is said that no callus was present in six cases. These pictures were taken on the thirty-fifth, fifty-sixth, fifty-seventh, eighty-eighth, ninety-fifth and one-hundred-fourteenth days. All obtained solid union except the last two. One of these I have been unable to locate and the other is the patient mentioned later as being still in the Montefiore Hospital at ten months.

*Union.*—The time of bony union is not mentioned in ten cases. In fifteen

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patients it was noted that firm union occurred at periods varying from twenty-five to one hundred nine days with an average of fifty-two days. Solid union is mentioned on sixteen charts as having occurred at periods varying from thirty-eight to two hundred ninety days with an average of ninety-two days. This included cases requiring one hundred, one hundred twenty, one hundred thirty-three, one hundred fifty-four and two hundred ninety days, respectively, so that the average of the remainder was considerably below ninety-two days. The patient whose fracture was solid in thirty-eight days was thirteen years old. It is definitely known that solid union was obtained in all except four patients. Two of these showed satisfactory callus formation

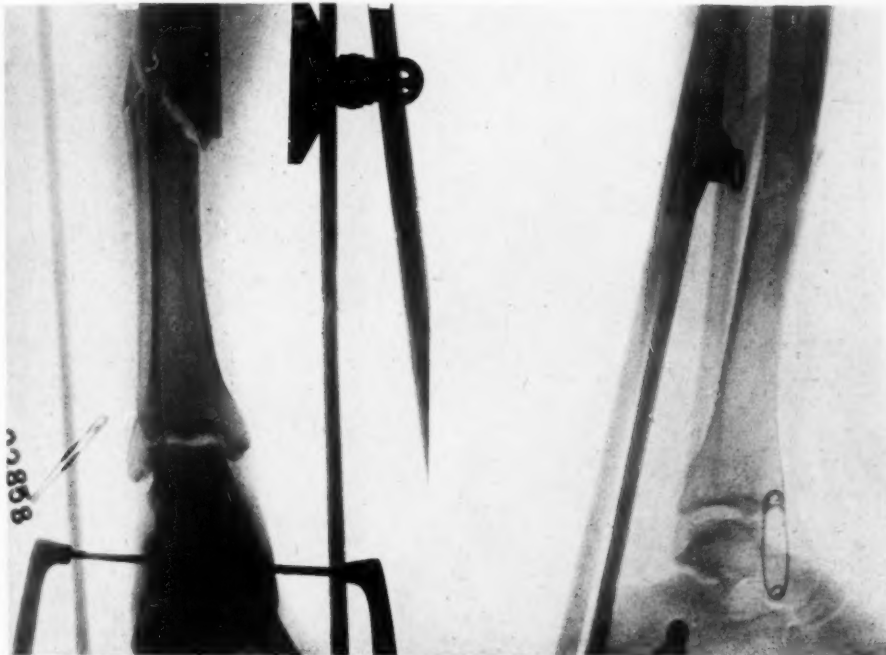


FIG. 4A.—Case No. 10145. Shows good axis and slight overpulling with traction applied by Steinman pin.

when discharged less than thirty days after injury. They could not be traced but with callus appearing in this short time there seems little doubt that they obtained solid union. The third patient, No. 12181, showed no evidence of union at one hundred fourteen days and had a posterior angulation of forty degrees. He had been treated by Steinman pin. He was aged fifty-two and in bad general condition, suffering from generalized arteriosclerosis, auricular fibrillation, *etc.* He was transferred to Montefiore Hospital at four months. At ten months it was reported to me that he was still in the hospital, walking with a cane with the leg in plaster, and that union was progressing slowly. However, I have entered him as non-union. The fourth patient did not have union at the ninety-fifth day. I have been unable to locate him and he may have non-union. This gives at most 6.5 per cent. non-union. The



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patient who did not have solid union until two hundred ninety days was a compound fracture with osteomyelitis and sequestration.

The rating of the anatomical result was not possible in three cases as they were transferred to other hospitals before union was obtained. Of the remaining thirty-two patients twenty-four were rated A<sup>2</sup>, seven A<sup>3</sup>, and one has non-union.



FIG. 5.—Case No. 7028. Oblique fracture of both bones with displacement of lower fragments backward. Reduction and plaster splints. Fragments slipped as shown above.

*Deformity in A<sup>3</sup> patients.*—No. 3528.—One-half-inch shortening, compound fracture, treated in plaster splints.

No. 5019.—Apposition 50 per cent. treated in plaster splints.

No. 8156.—One-half-inch shortening, occurring after Steinman pin was removed on thirtieth day and plaster splints applied.

No. 9047.—Angulation with convexity anteriorly and laterally; fragment pierced skin late following necrosis of skin over it and a low-grade osteomyelitis was set up; treated with Steinman pin.

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No. 9098.—Angulation of thirty degrees with convexity outward, treated in adhesive plaster traction because of large loss of tissue at heel; also had ice tongs in femur for fracture of shaft of femur.

No. 11063.—Apposition 50 per cent.; treated by Steinman pin traction; also had ice tongs in femur for fracture of femur same side.

No. 11172.—Apposition 50 per cent., treated in plaster splints.

*Late results.*—The result after one year was obtained in seventeen patients. In fourteen this was E<sup>4</sup>, F<sup>4</sup>. In two the economic result is not known but functionally they are F<sup>3</sup> and F<sup>2</sup>, respectively. The other patient is still in a hospital with non-union.

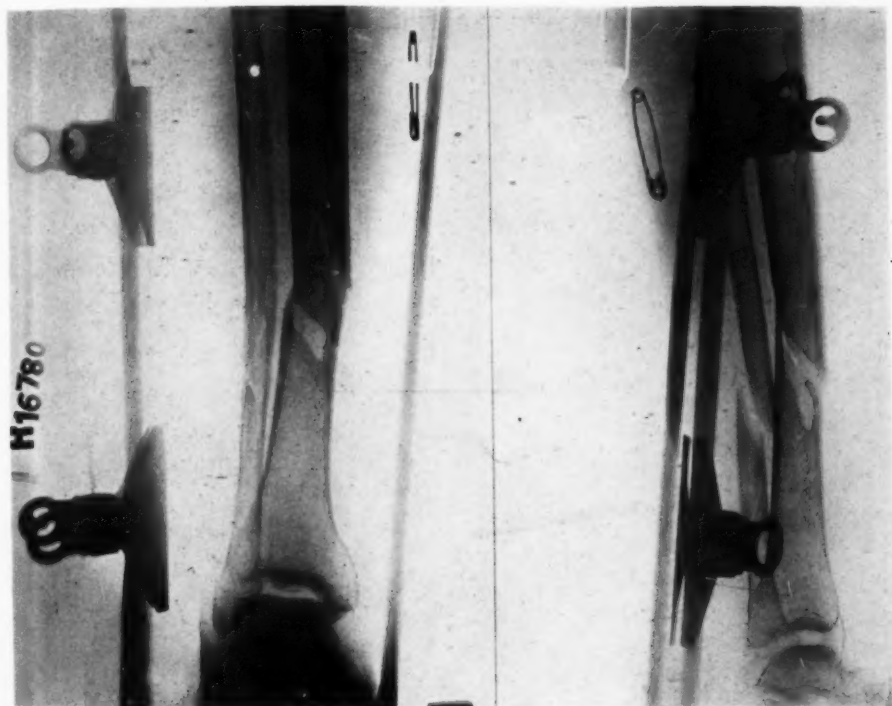


FIG. 5A.—Case No. 7028. Good alignment with traction by Steinman pin.

No. 6207.—A<sup>4</sup>, E unknown, F<sup>3</sup>.—Compound, comminuted fracture with osteomyelitis. At twenty-two months still complained of pain in ankle and some limitation of dorsiflexion of foot.

No. 9047.—A<sup>3</sup>, E unknown, F<sup>2</sup>.—Had an infected hæmatoma at site of fracture with subsequent osteomyelitis. Wound remained open for nine months. Treated by Steinman pin and had splints on up to four months. Case settled by Department of Labor at one and one-half years giving him 50 per cent. disability on account of defective motion of both knee and ankle. I doubt if this is permanent.

Of the six other patients with A<sup>3</sup> result, four had E<sup>4</sup>, F<sup>4</sup> and two could not be traced.

The progress of the patient was complicated in four instances as follows: *Gas bacillus infection*, one. No. 1923.—Severe compound, comminuted

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fracture. Débrided, wound left open, and treated by Carrel-Dakin method with leg in plaster splints. Three days later showed definite gas bacillus infection. Leg laid open from two inches below knee to internal malleolus. Given four hundred cubic centimetres of tetanus perfringens serum intravenously in twenty-four hours. Made a good recovery and was up in wheel chair on twenty-ninth day. Result A<sup>4</sup>, E<sup>4</sup>, F<sup>4</sup>.

*Infected hæmatoma, one.*

*Necrosis of skin over bone with later discharge of superficial bone fragments, two.*

There were no amputations and no deaths in this group. There were no open reductions, except manual reduction at the time of débriding compound



FIG. 5B.—Case No. 7028. Position at six weeks. Pin has been removed and plaster splints applied.

fractures. Five patients did not have solid union until after one hundred days and must be considered delayed union, *i.e.*, 14 per cent.

LOWER THIRD.—In this group there were fifty patients of whom forty-four were male and six female. Their ages were as follows: 0 to 15 years, 11; 16 to 29 years, 11; 30 to 39 years, 9; 40 to 49 years, 8; 50 to 59 years, 8; 60 to 69 years, 2; 70 to 79 years, 1. Thirty-nine were simple and eleven were compound fractures. Four were apparently compounded from within and seven from without. Twenty-seven, or over half, were comminuted. Thirty-three were apparently injuries by direct violence. Twenty-two were from automobile accidents. Ten patients had other injuries, but none of these lengthened their stay in the hospital. These were as follows:

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- CASE No. 2506.—Fracture of four metatarsals and two toes.  
CASE No. 3778.—Fracture of upper third of shaft of humerus.  
CASE No. 4605.—Fracture through external condyle of femur.  
CASE No. 4672.—Fracture of greater tuberosity of humerus.  
CASE No. 6895.—Fracture of base of fifth metatarsal.  
CASE No. 8167.—Dislocation of shoulder.  
CASE No. 9248.—Fracture of all metatarsals.  
CASE No. 9908.—Fracture of internal malleolus.  
CASE No. 10897.—Fracture of radius and ulna, middle third.  
CASE No. 12593.—Dislocation of foot.

*Treatment.*—Of the fifty patients, thirty-six were treated primarily by immobilization in posterior and lateral molded plaster splints. In fourteen of these an anæsthetic was given and a manual reduction done before the application of splints. In the remainder no anæsthetic was given because only slight or no manipulation was necessary. Two of these reductions were done under the fluoroscope. This primary treatment was unsuccessful in seven patients. Two of these were satisfactorily reduced by a second manipulation under general anæsthesia with application of plaster splints. The remaining five had traction-suspension treatment by means of Steinman pin through the os calcis.

Thirteen patients had a Steinman pin inserted as their primary treatment, *i.e.*, the Steinman pin was used altogether eighteen times. Fifteen pounds' traction were usually employed in the primary cases, later reduced to ten, and twenty to thirty pounds employed in the secondary cases. The Steinman pin broke in one case on the thirty-fourth day and was removed. In another case it was removed before the patient's transfer to Bellevue Hospital on the sixteenth day. One patient died after seventy-two hours and another had an amputation on the twenty-fifth day. In the remaining cases it was left in for periods from twenty-seven to seventy-seven days, with an average of forty-three days. Omitting the probable non-union case mentioned later, in whom the pin was left for seventy-seven days, the average duration of this treatment was forty days. On removing the pin, one patient had adhesive plaster traction suspension for a time and the remainder were placed in plaster splints. Of the eighteen patients treated by traction suspension ten were simple and eight compound fractures.

In all patients the wounds at the site of the Steinman pin healed promptly. In two cases, however, abscesses developed later.

CASE No. 2954.—Wounds healed promptly and never reopened. Four and a half years later he was admitted to the hospital with an abscess on the external aspect of the heel deep to the scar of the pin wound. This was incised and found to lead down to bare, rough bone. It was drained, healed promptly and he has had no further disturbance for the past year.

CASE No. 11894.—The pin broke during treatment and was removed. Wounds healed promptly. Six months later he was readmitted to the hospital on account of persistent pain in the heel. Radiograph showed a small piece of metal lying in the centre of the os calcis surrounded by an abscess two centimetres in diameter. This was opened, metal removed and drained. The wound healed promptly and has given no more trouble for

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the past six months. The pin used in this case was of the screw type, which we do not believe is advisable.

One patient had an open reduction on the fifth day with the application of a vanadium steel plate and immobilization in plaster splints. Seven patients

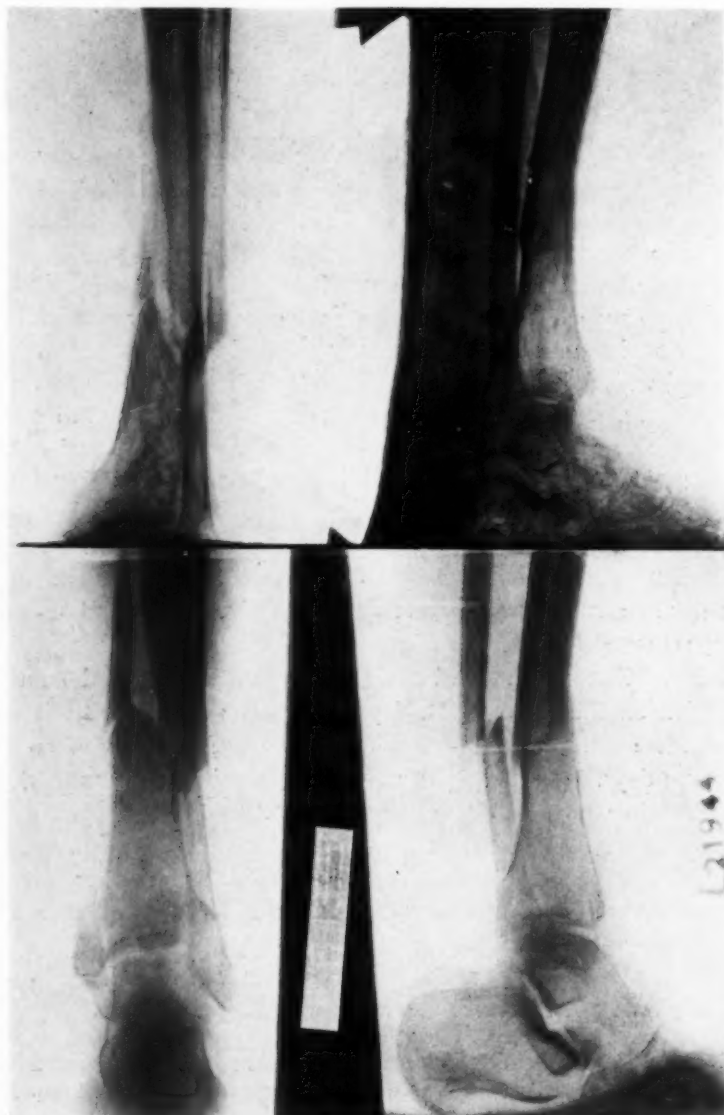


FIG. 6.—Case No. 9908. Comminuted fracture of both bones, lower third. Lower views show position on admission. Upper views show position at forty days after traction has been removed and callus has begun to form.

with compound fractures had a débridement done on the day of admission and in five of these a manual reduction was done with the bones visible in the depth of the wound. Of these, splints were applied afterwards in three cases and a Steinman pin used in two.



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In three cases the Delbet splint was applied late for weight bearing. It was not used as a primary treatment.

*Callus.*—The first appearance of callus is mentioned in the X-ray report in nine cases at periods varying from twenty to seventy-three days, with an average time of thirty-nine days. Omitting two children of ten and eleven years who showed callus in twenty-eight and thirty days respectively, the average time for noting first appearance of callus was forty-two days. The earliest appearance of callus in an adult was twenty days. On the last X-ray report while in hospital it is mentioned that no callus was present in twelve cases. These pictures were taken on the twenty-seventh, twenty-seventh, thirtieth, thirty-second, thirty-fifth, thirty-sixth, thirty-ninth, forty-third, forty-fifth, forty-seventh, sixty-ninth and ninety-first day. In the first seven

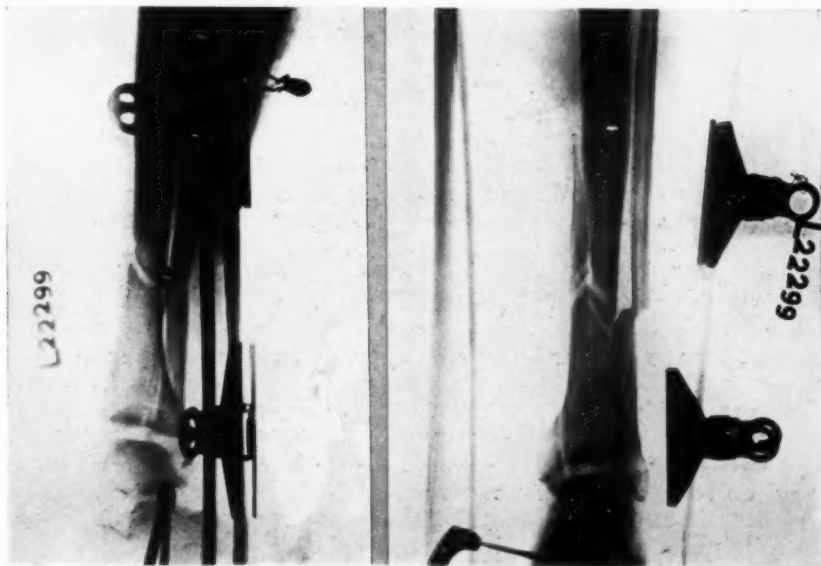


FIG. 6A.—Case No. 9908. Shows position of fragments maintained in traction by Steinman pin. No overriding. Good axis.

one would hardly expect to see callus judging from the average time mentioned above. Of the other five we know that three obtained solid union. The patient who showed no callus at forty-five days I have been unable to locate. The patient who showed no callus at ninety-one days still had a false point of motion at fifteen months. Operation was advised from three months on because of the delay in union but the patient persistently refused. I believe he has periosteum or fascia between a portion of the fragments.

*Union.*—Three patients died, two had amputations and nine could not be traced. In all of these nine, the condition was such when last seen that one would expect good union. Of the remaining thirty-six, it is definitely known that thirty-five obtained solid union, or 97 per cent. The one remaining patient was discussed above under "callus" and had non-union when last seen at fifteen months. As regards the time of union, it is entered on the charts

that eighteen patients showed firm union at periods varying from twenty-eight to seventy-four days, an average of forty-nine days. Solid union is mentioned on seventeen charts as having occurred at periods varying from thirty-two to eighty-six days, with an average of fifty-seven days. The patient showing solid union at thirty-two days was seven years old. A man of twenty-three had solid union at thirty-six days and one of fifty-five at thirty-seven days.

### *Complications.*

#### *Deaths, 3.*

CASE No. 2718.—Simple fracture of tibia and fibula at junction of middle and lower thirds with forward and inward displacement of lower fragments. Condition satisfactory before anaesthetic, not being in much shock. Heart and lungs negative. Ether anaesthesia lasting twenty minutes. Under fluoroscope the fragments were brought into alignment with slight traction and manipulation. Two lateral molded plaster splints were applied. The patient vomited as he came out of the anaesthetic. He had reacted completely one hour after administration. Three and one-half hours after manipulation he became cyanotic with considerable respiratory distress, slight cough and bloody expectoration. Died two hours later, apparently of pulmonary embolism. Autopsy not obtained.

CASE No. 6954.—Severe compound fracture of both bones of the leg, lower third. Under gas-oxygen-ether anaesthesia wound débrided and Steinman pin inserted in os calcis. Forty-eight hours later developed delirium tremens. At this time also there was suggestion of gas at upper end of wound. Given sixty cubic centimetres of tetanus perfringens serum. Delirium continued and patient died seventy-two hours after injury. We believed his death was due to delirium tremens and not to gas bacillus infection *per se*. No autopsy.

CASE No. 12593.—A man of seventy in poor general condition sustained a simple fracture of both bones of the leg in the lower third, a fracture of the lower extremity of the tibia and a dislocation of the foot. Reduction was attempted without anaesthesia on the first and fourth days, but the fragments slipped each time. On the eighth day a third attempt was made under spinal anaesthesia. The circulation was poor and blebs developed. On the thirteenth day a streptococcus infection of the skin was noted. It was decided that his general condition did not warrant serum therapy. He died on the fifteenth day apparently of sepsis. No autopsy obtained.

#### *Gas bacillus infection, three.*

CASE No. 2954.—Severe compound comminuted fracture of both bones at the junction of the middle and lower third. Débridement, manual reduction, closure of wound. Gas bacillus infection evident within twenty-four hours. Opened widely and given four hundred cubic centimetres of tetanus perfringens serum intravenously in one-hundred-centimetre doses. Had a prolonged but excellent recovery.

#### *CASE No. 6954.—See above under "Death."*

CASE No. 9462.—Severe compound fracture of both bones of leg, lower third. Débridement, manual reduction, Steinman pin, wound left open. On the third day showed evidence of gas infection. Leg was opened widely and the patient was given tetanus perfringens serum. Gas infection was controlled within forty-eight hours, but a colon bacillus infection persisted requiring repeated incisions. The process continued to extend and a disarticulation through the knee-joint was done on the twenty-fifth day. Later, after the wound had cleaned up, an amputation was done through the lower thigh and patient made a good recovery.

#### *Amputations, two.*

CASE No. 2506.—A man of sixty-five with markedly sclerotic blood-vessels sustained a simple comminuted fracture of both bones of the leg in the lower third, a fracture

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of four metatarsals and of two toes. He developed many blebs after the first reduction. This was unsatisfactory and a second reduction was attempted at which some of the blebs were broken. He developed many large ulcers of the foot and ankle so that an amputation was done through the middle of the leg on the twenty-second day. He made a good recovery.

CASE No. 9462.—See above under "gas bacillus infection."

*Osteomyelitis*, one.

One patient with a compound fracture developed an abscess with a superficial osteomyelitis, which healed in a brief period spontaneously.

In this series the fractures of the lower third of tibia and fibula presented complications more frequently and of greater severity than in the other groups.

The rating of the anatomical result was not possible in six cases as they were transferred before union was obtained. Three others died and two amputations were performed. Rating was therefore possible in thirty-nine cases. Of these thirty-one were A<sup>4</sup> and eight A<sup>3</sup>.

*Deformity* in A<sup>3</sup> patients.—CASE No. 6130 A<sup>3</sup>.—Fifteen degrees' angulation outward at site of fracture.

CASE No. 6895 A<sup>3</sup>.—Badly comminuted and shows considerable thickening immediately above ankle-joint, axis normal.

CASE No. 7279 A<sup>3</sup>.—Lower fragment of tibia displaced outward and forward, sixteen years of age.

CASE No. 8167 A<sup>3</sup>.—Moderate pronation of foot on weight-bearing.

CASE No. 8816 A<sup>3</sup>.—Fifteen degrees' angulation and one-fourth-inch forward displacement of lower fragment in patient thirteen years of age.

CASE No. 10775 A<sup>3</sup>.—Some visible deformity with slight dishing.

CASE No. 10897 A<sup>3</sup>.—Slight abduction of lower fragments of both bones; slight pronation of foot.

CASE No. 12701 A<sup>3</sup>.—Oblique fracture with one-half-inch shortening.

Four of these A<sup>3</sup> patients were treated by traction and four by plaster splints.

*Late result*.—The result after one year was obtained in eighteen patients. In fifteen this was E<sup>4</sup>, F<sup>4</sup>. In two of the remaining three it was E<sup>4</sup>, F<sup>3</sup> and in the other F<sup>3</sup>, but the economic result is not known as compensation had not been settled and the patient had not returned to work.

CASE No. 6895 A<sup>3</sup>, F<sup>3</sup>.—Has not returned to work at one year. Has about one-half normal range of motion at ankle-joint.

CASE No. 10775 A<sup>3</sup>, E<sup>4</sup>, F<sup>3</sup>.—At one year still complained of discomfort in ankle region and at site of fracture, increased by weight bearing. Had been at usual work several months.

CASE No. 11860 A<sup>4</sup>, E<sup>4</sup>, F<sup>3</sup>.—Moderate loss in mobility at ankle-joint in all directions.

In addition, there is one patient with non-union. Two of the A<sup>3</sup> patients are mentioned above. Two others could not be traced. The remaining four with A<sup>3</sup> result all had E<sup>4</sup>, F<sup>4</sup>.

In addition to the above groups of patients there were seven admitted to the hospital who had fractures of the shaft of both bones of the leg. This injury was only an incident among multiple severe injuries and all died of shock within twenty-four hours. Four were automobile accidents. In all the only treatment instituted was immobilization and the routine for shock. They are not included in the detailed report.

The patients in all these groups have had heat and massage, which are commenced as early as it is practical. If the leg is in splints, the lateral splint is removed by the third or fourth day and this treatment is given daily, unless it is believed that the danger of slipping is too great. Active motion at the ankle-joint is encouraged early. If a simple fracture is in traction, heat and massage are begun about the same time as in plaster. In compound fractures the time depends on the condition of the wound. Passive motion is reserved until such time as union is fairly firm, believing that otherwise the operator may do damage. However, much can be accomplished by getting the early coöperation of the patient in active motion. Eleven of the earlier patients in this group received diathermy. It was stopped because not only did we fail to find it of value, but in several cases we felt definitely that callus was absorbed during its use and the time of healing prolonged.

In these patients we have used various chemical aids in treatment, *vis.*, calcium chloride, calcium with phosphates, thyroid extract, parathyroid extract, irradiated ergosterol and cod-liver oil. This has been done from the day of admission on series of cases and it has also been used on definitely delayed cases. We have no evidence that any one of these is of the slightest value, either in normal or delayed healing. We still use cod-liver oil in most of these cases, believing that there may be some nutritious effect for the patient confined to bed for a prolonged period. All the other chemical aids have been discarded.

## SUMMARY

1. This is an analysis of 107 patients with fractures of both bones of the leg, not involving the joints, of the following types: (a) Spiral, thirteen; (b) upper third, nine; (c) middle third, thirty-five; (d) lower third, fifty.
2. The age grouping was as follows: 0 to 15 years, fifteen; 16 to 29 years, twenty-seven; 30 to 39 years, twenty-two; 40 to 49 years, twenty; 50 to 59 years, seventeen; 60 to 69 years, five; 70 to 79 years, one. About two-thirds of the patients were between the ages of sixteen and fifty.
3. There were ninety-seven males and ten females.
4. Sixty-two fractures appear to have been sustained by direct and forty-five by indirect violence. Thirty-nine patients were injured in automobile accidents.
5. Eighty were simple and twenty-seven compound fractures. Sixty were comminuted fractures.

*Treatment.—Primary.*—Plaster-of-paris splints, seventy; traction by Steinman pin through os calcis, thirty; traction by ice tongs, four; traction by adhesive plaster, two; open operation (Lane plate), one.

The position of the fragments in plaster was unsatisfactory eleven times and in two cases treated by ice tongs, which slipped.

*Secondary, i.e., primary* was unsatisfactory, fourteen—Traction by Steinman pin, seven; traction by ice tongs, four (one reinserted); traction by adhesive plaster, one; open operation (Lane plate), one; open operation for interposition (kangaroo-tendon sutures), one.

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The ice tongs slipped in three of these cases. The Steinman pin was substituted in two and adhesive plaster in one.

Traction suspension was used in some form on forty-six patients. The Steinman pin was used during treatment thirty-nine times. Ice tongs were used eight times and were unsuccessful five times. Open operation with Lane plating was done twice, and with kangaroo-tendon sutures once.

When the treatment was completed, the average time for retaining the Steinman pin or ice tongs was forty-eight days. All pin and tong wounds healed promptly, but there were two late abscesses.

7. Of the entire series, callus was first noted in the X-ray in forty cases as appearing in an average time of forty days. The average period before solid union was obtained was: Spiral, eighty-four days; upper third, ninety-five days; middle third, ninety-two days; lower third, fifty-seven days.

Among the twenty-seven compound fractures there were five gas bacillus infections. All had wide incisions and tetanus perfringens serum. Three made excellent recoveries. In one patient the gas bacillus infection was readily controlled but he had a late amputation because of continual pocketing and spreading of pus, apparently chiefly of the colon group. One died on the third day, apparently of delirium tremens.

9. *Results.*—Death, three; amputation, three; cases transferred to other institutions too early to be certain of result—position in all such as to expect solid union, eleven; cases discharged from hospital too early for union to be solid, and could not be traced—no reason to expect delayed union in any, five; known solid union, eighty-two; known non-union, two; probable non-union, which cannot be traced, one.

10. Those patients on whom hospital treatment was completed actually remained in the hospital for an average period of sixty-six days.

11. *Rating.*—Forty-two were rated according to the Massachusetts General Hospital rating after one year as follows: A<sup>4</sup>, E<sup>4</sup>, F<sup>4</sup>, twenty-five; A<sup>4</sup>, E<sup>4</sup>, F<sup>3</sup>, one; A<sup>4</sup>, E<sup>0</sup>, F<sup>4</sup>, two; A<sup>4</sup>, E<sup>0</sup>, F<sup>3</sup>, one; A<sup>3</sup>, E<sup>4</sup>, F<sup>4</sup>, nine; A<sup>3</sup>, E<sup>4</sup>, F<sup>3</sup>, one; A<sup>3</sup>, E<sup>0</sup>, F<sup>3</sup>, one; A<sup>3</sup>, E<sup>0</sup>, F<sup>2</sup>, one; A<sup>2</sup>, E<sup>0</sup>, F<sup>3</sup>, one.

The E<sup>0</sup> cases were those whose compensation had not been settled when last heard of and had not attempted to return to work.

In addition there were thirty-six patients with an A<sup>4</sup> result and four with an A<sup>3</sup> result whose economic and functional results are not known.

Averaging the time before returning to work in New York City does not give a correct picture of the duration of disability. Most of these patients are covered by the compensation laws and do not return to work until their cases have been settled. For various reasons this is often delayed long after a man is fit for work. Particularly is this true because there is no arrangement for part time or light duty, but a man must return to full time on his old job or be given a per cent. of permanent disability. This permanent disability frequently improves rapidly after compensation is settled.

We cannot insist too strongly that fractures deserve thorough treatment and that better results can be obtained on services where special interest is



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shown in them. There is no single method applicable to all types in all places. We have presented one group of fractures in which the more complicated cases have been treated largely by methods of traction suspension. We do not believe this method is any easier or requires any less training than open reduction. We do believe that traction is less dangerous to the patient than an open operation if he is to be treated by a surgeon who only occasionally sees a major fracture.

Further, traction is important as a method of treatment because it gets us into the habit of expecting bones to unite without overriding and in the proper axis. Union is a most necessary factor, but the number of cases of malunion can be considerably diminished by the proper application of the methods of traction. Several clinics believe in early weight bearing and have their patients return to industry wearing splints. We cannot do that usually in New York as a man does not return to industry until his compensation case is closed. We believe in early motion and late weight bearing, *i.e.*, after union is solid.

Theoretically, traction exerted on the lower end of the tibia is preferable to that brought through the ankle-joint. Practically, we have not been satisfied with ice tongs in the malleoli and have given this up in favor of the Steinman pin through the os calcis. We have not seen loss of function nor instability of the ankle-joint which we felt could in any way be attributed to the prolonged pull through the ligaments of the ankle-joint.

For the type of patient we have in the district where we work, we believe that in fractures of the shaft of both bones of the leg, traction suspension in complicated cases offers the best chance of a good result in a reasonable time.

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## THE COMPARATIVE VALUE OF METAPHEN IN ALCOHOL- ACETONE-AQUEOUS SOLUTIONS IN THE PRE-OPER- ATIVE DISINFECTION OF THE SKIN

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PERHAPS in no branch of surgical technic has there been a greater diversity of opinion than in that of pre-operative skin disinfection. The existence of this difference of opinion has been indicated by the colorful array of pre-operative skin disinfectants in daily use in the larger surgical clinics throughout this country. The reason behind this confusion has been that up to the present moment no chemical nor combination of chemicals has possessed the varied and exacting properties required of the ideal pre-operative skin disinfectant.

In addition to possessing high bactericidal action as well as deep penetrability, the ideal skin disinfectant must meet certain other definite requirements before it is worthy of consideration in pre-operative skin sterilization. It must not cause pain at the time of application, nor dermatitis subsequently. The method of application must be simple and the drying time should be so regulated that sterilization and penetration can be accomplished with a minimum loss of time. It must be capable of dissolving the skin debris, consisting of glandular secretions and excretions, degenerative cellular products, and dirt in which bacteria are so frequently found. Within the microscopic crevices of the skin are very tiny air bubbles which must be decomposed and removed by the disinfecting solution before satisfactory penetration and sterilization can be accomplished. As a protection against any retardation of the process of wound healing following its use, the preparation must be of relatively low toxicity to normal tissue and also should not precipitate in the presence of blood serum. Lastly, the ideal skin disinfectant should have a sufficiently high color in order to remove any doubt concerning the extent of the field prepared for operation.

Although the iodine-alcohol technic of skin disinfection fails in many respects to meet the requirements mentioned above, it has been in more or less general use since its introduction by Grossich<sup>1</sup> in 1908. It has been well known that some individuals, especially those suffering from hyperthyroidism, have a marked idiosyncrasy to iodine, and that in these cases annoying skin irritation has sometimes resulted from its use. The drug also has tended to concentrate along the margins of the field and unless special care was exercised in removing these marginal accumulations, skin burns occurred. The removal of the iodine with alcohol before the patient was draped and the skin incision was made possessed two objectionable features. In the first place, such a method was quite time-consuming, and, secondly, the

extent of the field prepared for operation was ill-defined following the removal of the compound. It has been claimed by some investigators, among these O'Connor<sup>2</sup> and Maylard,<sup>3</sup> that iodine used in the peritoneal cavity results in the development of severe post-operative adhesions. When tincture of iodine was mixed with blood serum, precipitation always occurred with subsequent loss of bactericidal power.

The 5 per cent. alcoholic solution of picric acid has not been generally accepted as a pre-operative skin disinfectant for a number of reasons. Occasionally, severe skin irritation has occurred following its use. The tendency to crystallize and the slow drying time have also been objectionable features. The picric acid solution not only stained the operating-room sheets and towels at the time of operation, but also discolored the patient's clothing, bedding, *etc.*, for a period of several days following its use. Furthermore, linen that had been saturated with picric acid solution and then allowed to dry was inflammable, a fact that had always to be remembered when the use of the cautery or diathermy was contemplated.

Neutral acriflavine has not lent itself to pre-operative skin disinfection for a number of reasons. As shown by Browning and colleagues,<sup>4</sup> Graham-Smith,<sup>5</sup> and others, this compound possessed a very slow killing rate and a high inhibitory power. Dakin and Dunham<sup>6</sup> have shown that a 1 to 1000 dilution of acriflavine required more than six hours to kill staphylococcus aureus in blood serum, muscle extract, or in defibrinated blood. Young and his co-workers<sup>7</sup> have shown that a solution of 1 to 200 of neutral acriflavine suspended in 50 per cent. dog serum failed to kill bacillus coli in one hour. A 5 per cent. solution of neutral acriflavine dissolved in 50 per cent. alcohol and 10 per cent. acetone, as advocated by Tinker and Sutton,<sup>8</sup> had to be used in fresh preparations if its maximum efficiency as a skin disinfectant was desired. The lack of stability plus its relatively high cost have tended to decrease its popularity as a pre-operative skin disinfectant even if in other respects it had met the requirements of the ideal preparation.

Because of its tendency to cause smarting and burning of the skin at the time of its application, "Kalmerid," a 1 per cent. solution of potassium mercuric iodide in 80 per cent. acetone, has decreased in its popularity with the increasing use of local anæsthesia in surgery. Cases of marked dermatitis have occasionally been observed in urology following the use of "Kalmerid" on the external genitalia. Furthermore, when this solution was mixed with blood serum, precipitation occurred rapidly, resulting in a marked loss of bactericidal power.

The search for a pre-operative skin disinfectant which could be used upon the delicate epidermis of the external genitalia without fear of discomfort at the time of application or subsequent dermatitis, resulted in the introduction of an alcohol-acetone-aqueous solution of mercurochrome by Scott and Hill.<sup>9</sup> This preparation was made by dissolving two grams of crystalline mercurochrome in thirty-five cubic centimetres of distilled water, and then adding, while stirring, fifty-five cubic centimetres of 95 per cent. alcohol and

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ten cubic centimetres of acetone. The persistence of the stain in the operating room, on linen, clothing, *etc.*, has been the most common objection to the use of this preparation.

Realizing that any further progress in the development of the ideal skin disinfectant depended upon the introduction of a chemical possessing more nearly the bactericidal and other properties required of such a preparation, we were finally apprised of the literature on metaphen. Provided the claims made for this germicide could be substantiated, it seemed to us that metaphen would be very suitable for our purposes. At first we experimented with the 1 to 500 alkaline-aqueous solution of metaphen and shortly concluded that it possessed no value in skin sterilization. Because of its enormous antiseptic powers against the commonly encountered microorganisms when tested against these *in vitro*, we were led to believe that the compound might become useful as a pre-operative skin disinfectant if we were able to obtain the crystalline form for the preparation of higher concentrations in alcohol and acetone. More than a year ago, therefore, we informed Doctor Raiziss, of the Dermatological Research Laboratories, of our hopes and requested his coöperation. He very generously sent us twenty grams of the crystalline compound. It seemed essential at first to evaluate the disinfectant and antiseptic properties of metaphen *in vitro* in comparison with other commonly used chemicals before we attempted a study of its disinfecting capacity on the skin.

This preparatory study, by one of us,<sup>10</sup> necessitated an extensive investigation of the disinfecting and antiseptic potency of bichloride of mercury, hexylresorcinol, the aqueous and alcohol-acetone solutions of mercurochrome, tincture of iodine and phenol, against staphylococcus aureus, streptococcus hæmolyticus, gonococcus, bacillus anthracis, bacillus coli and bacillus subtilis. These studies showed that *in vitro* metaphen possessed unusual disinfecting and antiseptic powers far in excess of bichloride of mercury, hexylresorcinol, mercurochrome, tincture of iodine and phenol. It was also demonstrated that metaphen had a low toxicity when injected intravenously in rabbits and that it failed to precipitate out serum proteins in dilutions as low as 1 to 200 and that it exerted no deleterious effect on surgical instruments or rubber. Because of these superior qualities we proceeded with our study of metaphen as a pre-operative skin disinfectant.

During this study, the article of Raiziss, Severac and Moetsch<sup>11</sup> appeared on metaphen as a skin disinfectant. The demerits of this study have been adequately discussed by Leonard<sup>12</sup> and White and Hill.<sup>13</sup> Unfortunately, the latter authors failed to carry the concentration of metaphen higher than a 1 to 500 dilution and erroneously concluded that the compound was unsuitable as a skin disinfectant.

Following a large series of discouraging results with various higher dilutions of both the aqueous and the alcohol-acetone-aqueous solutions of metaphen, we finally arrived at a formula which fulfilled our requirements. It has, of course, been commonplace knowledge that the efficiency of a disinfectant *in vitro* tests has been a far cry from that actually observed in carefully

conducted and controlled *in vivo* experiments. It was, therefore, no particular surprise to us to discover that, although the phenol coefficient of metaphen was 1,500 for staphylococcus aureus and 250 for bacillus coli when studied in the test tube, we were compelled to come down to an alcohol-acetone-aqueous solution of metaphen containing 0.5 per cent. (1 to 200 dilution) of the compound before it exercised its optimum efficiency as a pre-operative skin disinfectant. Since the 7 per cent. solution of tincture of iodine and the alcohol-acetone-aqueous 2 per cent. solution of mercuriochrome have been disinfectants of choice in leading surgical clinics today, the following comparative study was made with these two pre-operative skin disinfectants together with the alcohol-acetone-aqueous 0.5 per cent. solution of metaphen and a control solution containing the alcohol-acetone-aqueous base for both mercurial compounds employed. With these disinfectants, the first part of our study was performed on infected rabbit's skin and the last part on the unwashed human skin.

## EXPERIMENTAL

*Microorganisms employed.*—The study of disinfection on the rabbit's skin was performed with the following organisms commonly encountered in clinical conditions; *viz.*, staphylococcus aureus, streptococcus haemolyticus, bacillus coli and the spore-bearing organism, bacillus subtilis. The strains of these microorganisms were the same as those made use of in our previous *in vitro* study.<sup>10</sup> The ease with which these microorganisms were recognizable morphologically and culturally rendered them particularly useful in tracing the results of incomplete disinfection back to the original strain employed in the study. The presence of spores in bacillus subtilis was daily ascertained by staining these organisms by Dorner's method with carbol fuchsin and a saturated solution of aqueous nigrosine.

*Chemicals employed.*—(1) *Metaphen.*—The alcohol-acetone-aqueous 0.5\* per cent. solution of metaphen was prepared by dissolving 0.5 gram of crystalline metaphen (4, nitro-5-hydroxy-mercuri-ortho cresol,  $C_2H_2:CH_3ONO_2$ . Hg.) in a mixture of 50 cubic centimetres of 95 per cent. alcohol and 10 cubic centimetres acetone. To the completely dissolved mercurial compound was added slowly, and while stirring, a mixture containing 39 cubic centimetres of distilled water and 1 cubic centimetre of a 1 per cent. aqueous solution of eosin. This pinkish, opalescent solution remained stable in cork-stoppered amber-colored bottles for about four weeks when the mercurial compound slowly began to settle on the bottom. The drying period on rabbit and human skin was about three minutes. No discomfort was experienced on the intact skin of the abdomen, perineum and genitalia. The coloring was delicately pink and the painted area was quite visible. Because of its low surface tension the solution was easily and evenly spread over the skin surface. Linen and clothing soaked in the metaphen solution were readily cleaned with ordinary soap and water. This solution remained harmless to

\* See Addendum on page 596.



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metallic instruments and rubber. When 0.7 cubic centimetres of the solution was mixed thoroughly with 1 cubic centimetre of human serum, precipitation did not occur. The precipitation which did occur at higher concentration was due to the lack of solubility of the mercurial compound in water, rather than to a combination between the constituents of the blood serum and the mercury. Repeated local applications on the skin failed to produce destruction of the surface epithelium.

(2) *Tincture of iodine*.—The 7 per cent. tincture of iodine alcoholic solution was prepared according to the U.S.P. formula, 100 cubic centimetres containing 7 grams iodine and 5 grams potassium iodide dissolved in 1 cubic centimetre of distilled water and mixed with 95 per cent. alcohol.

(3) *Alcohol-acetone-aqueous 2 per cent. mercurochrome*.—This was prepared according to the formula by Scott and Hill<sup>9</sup> and described previously.

(4) *Alcohol-acetone-aqueous solution*.—This control solution was prepared by mixing 50 cubic centimetres of 95 per cent. alcohol, 10 cubic centimetres acetone, 39 cubic centimetres distilled water and 1 cubic centimetre of a 1 per cent. aqueous solution of eosin (the solvent for mercurochrome and metaphen).

*Technical procedure in rabbit-skin disinfection*.—The normal and adult rabbit was strapped down on the dog operating table. The abdomen was completely depilated by applying to the moistened hair a semi-liquid mixture containing one part of barium sulphide and two parts of flour. After depilation was completed, care was taken to remove the chemical thoroughly by allowing lukewarm water to run over the skin. Usually an area measuring fifteen by twenty-five centimetres was prepared and this was subsequently marked off by a red wax pencil into sixty small squares, each measuring about twenty-five square millimetres. The centre of each square was heavily infected with an undiluted eighteen-hour broth culture of one of the strains of microorganisms employed, and allowed to dry. The actual position of the culture was readily visible upon drying owing to its glistening surface. To each area the disinfectant solution was applied by means of an absorbent cotton swab. A contact of exactly three minutes was allowed between the application of the disinfectant and the removal of the culture from the centre of the treated area. The culture was obtained by the following technic: Two wooden applicator cotton swabs (165 by 2 millimetres), previously sterilized in cotton-plugged test tubes (125 by 15 millimetres) for one hour at 156° C., were slightly moistened at their extreme tips in 1 cubic centimetre of sterile broth. The swabs were vigorously rubbed against the centre of the treated area and then with a twirling motion of the fingers the culture was removed. Under strict aseptic conditions the swabs were immediately immersed in 100 cubic centimetres of Douglas' broth contained in a 250 cubic centimetre Erlenmeyer flask. After incubation for forty-eight hours at 37° C., the results of skin sterilization were read. This technic was observed with all the disinfectants employed. The areas not treated with any disinfectant served for control purposes. During the course of this study we were con-

stantly watching for the occurrence of self-disinfection of the skin as recorded by Arnold and his co-workers,<sup>14</sup> a phenomenon not observed by us on the infected rabbit's skin or the unwashed human skin of the upper and inner surfaces of the thigh. Our control material always showed bacterial growth after forty-eight hours' incubation at 37° C., in either Döuglas' broth or the ordinary meat extract broth (pH. 7.6). We were also anxious to guard against the transfer to the culture flasks of sufficient disinfectant on the moistened cotton swab, which, in itself, would produce sterilization. With this in mind we inoculated every flask found to be sterile after incubation with one drop of an eighteen-hour broth culture of the strain of bacterium employed in the original test. Subsequent growth following the usual incubation indicated that the original sterility was due to complete skin sterilization of the infected skin area. Furthermore, we endeavored to put each micro-organism and disinfectant to approximately identical experimental conditions by subjecting only one type of organism to the action of all the disinfectants studied, including the controls, on one and the same animal during the same hour of experimentation. When bacterial growth occurred in any one flask after forty-eight hours' incubation at 37° C., smears and cultures were made in order to ascertain that the test organisms were recoverable from the contaminated broth. Having fulfilled all these rigid control tests, the following results were obtained:

I.—*Skin surface disinfection with tincture of iodine, the alcohol-acetone-aqueous solutions of 2 per cent. mercurochrome and 0.5 per cent. metaphen after three minutes' contact with the infected rabbit's skin.*

One hundred separate skin-surface tests were performed with each of the four disinfectants under discussion for the evaluation of their sterilizing capacity against staphylococcus aureus, streptococcus hæmolyticus, bacillus coli and bacillus subtilis, respectively. The results of skin disinfection are shown

TABLE I

*Surface skin disinfection with tincture of iodine, alcohol-acetone solutions of mercurochrome and metaphen after three minutes' contact with infected rabbit's skin*

Microorganisms	Number of tests with each disinfectant	Number of sterile tests with				
		Tincture of iodine 7 per cent. sol.	Mercurochrome (2 per cent.) in alcohol-acetone sol.	Metaphen (0.5 per cent.) in alcohol-acetone sol.	Alcohol-acetone sol.	Controls
Staphylococcus aureus.....	100	90	38	88	0	0
Streptococcus hæmolyticus.....	100	76	57	93	0	0
Bacillus coli.....	100	82	70	87	0	0
Bacillus subtilis (spore).....	100	71	41	91	0	0
Percentage of complete sterilization (Average).....		79.7	51.5	89.7	0	0

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in Table I. The mercurochrome solution produced 51.5 per cent. of complete skin-surface disinfection against all the microorganisms tested; the tincture of iodine produced 79.7 per cent. complete disinfection; and the metaphen solution yielded 89.7 per cent. sterile results. All the skin areas treated with the control alcohol-acetone-aqueous solution, as well as those untreated and used for controls, showed bacterial growth.

II.—*Deep skin disinfection with tincture of iodine, the alcohol-acetone-aqueous solutions of 2 per cent. mercurochrome and 0.5 per cent. metaphen after three minutes' contact with the infected rabbit's skin (pinch grafts).*

For the evaluation of the ability of the disinfectant to penetrate deeply into the infected rabbit's skin, the technical procedure remained the same as that outlined above, except that instead of making surface swab cultures of the centre of the treated areas, small pinch grafts were removed from this region after the microorganisms had been exposed for three minutes to the action of the disinfectant. The scalpel and forceps employed in this study were sterilized in the dry oven for one hour at 156° C. The pinch grafts which were removed measured about three by three by two millimetres. These were immediately transferred to the flasks containing one hundred cubic centimetres of meat extract broth by means of sterile wooden applicator swabs. Twenty-five pinch grafts were removed from the areas treated with the four disinfectants under discussion and with the respective strains of bacteria. The same number of controls was removed from skin areas not treated by any disinfectants. The results of deep skin disinfection are shown in Table II.

In this crucial test of penetrability, we made the interesting and striking observation that neither mercurochrome nor tincture of iodine killed the spore-bearing bacillus subtilis, while metaphen effected 88 per cent. complete

TABLE II

*Deep skin disinfection with tincture of iodine, alcohol-acetone solutions of mercurochrome and metaphen after three minutes' contact with infected rabbit's skin (pinch-graft study)*

Microorganisms	Number of tests with each disinfectant	Number of sterile tests with				
		Tincture of iodine 7 per cent. sol.	Mercurochrome (2 per cent.) in alcohol-acetone sol.	Metaphen (0.5 per cent.) in alcohol-acetone sol.	Alcohol-acetone sol.	Controls
<i>Staphylococcus aureus</i> .....	25	14	2	21	0	0
<i>Streptococcus haemolyticus</i> .....	25	18	14	25	0	0
<i>Bacillus coli</i> .....	25	14	10	19	0	0
<i>Bacillus subtilis</i> (spore).....	25	1	0	22	0	0
Percentage of complete sterilization (Average).....		47	26	87	0	0

deep skin disinfection against this hardy organism. Aside from this spectacular capacity of metaphen, the total percentage of complete deep skin disinfection against all the four test microorganisms was 26 per cent. with the mercurochrome solution, 47 per cent. with the tincture of iodine solution and 87 per cent. with the metaphen solution. The control alcohol-acetone-aqueous solution failed to produce any deep skin disinfection while all the control pinch grafts showed growth of the respective microorganisms employed in addition to the normal bacterial flora of rabbit's skin. By inoculating all sterile flasks with one drop of an eighteen-hour broth culture of the strain of bacterium used originally, subsequent bacterial growth took place which indicated that the original sterility was not due to the transfer of enough chemical to induce antisepsis.

III.—*Surface-skin disinfection of unwashed human skin with tincture of iodine, the alcohol-acetone-aqueous solutions of 2 per cent. mercurochrome and 0.5 per cent. metaphen after three minutes' contact.*

Six adult and convalescent surgical patients volunteered their coöperation in these studies. The constancy of bacterial contamination of the upper and inner surfaces of the thigh renders these areas suitable for skin disinfection experiments. The individual tests were so arranged that the identical number of studies was made simultaneously on one and the same person with all the disinfectants under consideration. The technical procedure remained the same as that described on the rabbit's skin, except that the unwashed human skin was not purposely infected with bacterial cultures. The results of surface-skin disinfection are shown in Table III. Fifty-two separate skin surface tests were made with each disinfectant respectively. In 28.8 per cent. of the tests, complete surface-skin disinfection was obtained with the mercurochrome solution, in 96.1 per cent. with the tincture of iodine solution and in 98.0 per cent. with the metaphen solution. Only one in fifty-two tests of attempted skin disinfection with the control alcohol-acetone-aqueous solution was found to be sterile. The untreated areas showed bacterial growth

TABLE III

*Surface skin disinfection with tincture of iodine, alcohol-acetone solution of mercurochrome and metaphen after three minutes' contact with unwashed human skin*

Number of persons' skin tested	Number of tests with each disinfectant	Number of sterile tests with				
		Tincture of iodine 7 per cent. sol.	Mercurochrome (2 per cent.) in alcohol-acetone sol.	Metaphen (0.5 per cent.) in alcohol-acetone sol.	Alcohol-acetone sol.	Controls
6	52	50	15	51	1	0
Percentage of complete sterilization (Average).....		96.1	28.8	98.0	3.8	0

# DISINFECTANT VALUE OF METAPHEN

in every instance. Control tests showed that the sterile results obtained were not due to the transfer of sufficient amount of disinfectant to induce antisepsis.

## IV.—*Deep skin disinfection of human unwashed skin with tincture of iodine, the alcohol-acetone-aqueous solutions of 2 per cent. mercurochrome and 0.5 per cent. metaphen after three minutes' contact (skin-scraping tests).*

These tests were performed for the determination of the ability of the disinfectants under discussion to exercise deep skin sterilization. The unwashed skin on the upper and inner surfaces of the thigh was painted with the respective disinfectants including the control alcohol-acetone-aqueous solution. After the three-minute period of contact, the centres of the skin areas were scraped with scalpels sterilized in the dry oven for one hour at 156° C. The scraping proceeded until capillary bleeding occurred. The scrapings adhering to the knife-blade were removed under aseptic conditions by moistened wooden applicator swabs and were immediately suspended in 100 cubic centimetres of beef extract broth in 250 cubic centimetre Erlenmeyer flasks. The same technical procedure was followed in removing scrapings from the untreated control areas. The results obtained after forty-eight hours' incubation at 37° C. are listed in Table IV. Fifty-two separate skin-scraping tests were performed with each disinfectant respectively. Only two in fifty-two tests, or 3.8 per cent. complete deep skin disinfection was produced by the mercurochrome solution. Forty-four in fifty-two tests, or 84.6 per cent. of complete deep skin disinfection was obtained with the tincture of iodine solution, while forty-nine in fifty-two tests, or 94.2 per cent. of complete deep skin sterilization was produced by the metaphen solution. All the areas treated with the control alcohol-acetone-aqueous solution as well as those untreated showed bacterial growth. Our precautionary study of all sterile flasks proved that antisepsis was not due to direct transfer of disinfectant.

TABLE IV

*Deep skin disinfection with tincture of iodine, alcohol-acetone solutions of mercurochrome and metaphen after three minutes' contact with unwashed human skin (skin-scraping study)*

Number of persons' skin tested	Number of tests with each disinfectant	Number of sterile tests with				
		Tincture of iodine 7 per cent. sol.	Mercurochrome (2 per cent.) in alcohol-acetone sol.	Metaphen (0.5 per cent.) in alcohol-acetone sol.	Alcohol-acetone sol.	Controls
6	52	44	2	49	0	0
Percentage of complete sterilization (Average).....		84.6	3.8	94.2	0	0



## SCOTT AND BIRKHAUG

### SUMMARY

1. Surface skin disinfection with the 7 per cent. tincture of iodine, the alcohol-acetone-aqueous 2 per cent. solution of mercurochrome and the alcohol-acetone-aqueous 0.5 per cent. solution of metaphen, after three minutes' contact with infected rabbit's skin, has shown that the undiluted eighteen-hour culture of staphylococcus aureus, streptococcus hæmolyticus, bacillus coli and the spore-bearing bacillus subtilis were killed in 51.5 per cent. of tests with mercurochrome, 79.7 per cent. with tincture of iodine and 89.7 per cent. with the metaphen solution.

2. Deep skin sterilization (pinch grafts) of the infected rabbit's skin with the respective disinfectants and the stated microorganisms has shown that the mercurochrome and tincture of iodine solutions failed to kill the spore-bearing bacillus subtilis after three minutes' contact, while the metaphen solution produced 88 per cent. complete deep skin disinfection against this organism. The total deep skin disinfection against all the respective microorganisms was 26 per cent. with mercurochrome, 47 per cent. with tincture of iodine and 87 per cent. with the metaphen solution.

3. Surface-skin disinfection of the unwashed human skin was obtained in 28.8 per cent. of tests with mercurochrome, 96.1 per cent. with tincture of iodine and 98.0 per cent. with the metaphen solution.

4. Deep skin disinfection (scraping tests) of the unwashed human skin was obtained in 3.8 per cent. of tests with mercurochrome, 84.6 per cent. with tincture of iodine and 94.2 per cent. with the metaphen solution.

5. No surface or deep skin disinfection was obtained on the purposely infected rabbit's skin or the unwashed human skin with a control alcohol-acetone-aqueous solution.

### CONCLUSION

This comparative study of pre-operative skin disinfectants has shown that the alcohol-acetone-aqueous 0.5 per cent. solution of metaphen is relatively free from the objectionable features of solutions of tincture of iodine and the alcohol-acetone-aqueous 2 per cent. mercurochrome and that it fulfills under strictly controlled conditions the requirements of an efficient and non-deleterious pre-operative skin disinfectant.

ADDENDUM.—After this paper had gone to press, the authors succeeded in eliminating from the alcohol-acetone-aqueous 0.5 per cent. solution of metaphen the objectionable features of instability on prolonged standing and precipitation of blood proteins in higher concentrations. The addition of 2.5 cubic centimetres of normal sodium hydroxide per 100 cubic centimetres of the formula employed in this paper, resulted in an initial heavy precipitation which immediately dissolved on further addition of the required alkali. Repetition of a smaller series of the experiments performed in the present report has demonstrated that the improved formula retains the values of the original formula as an efficient and non-deleterious pre-operative skin disinfectant, and that it remains stable in solution and fails to precipitate blood serum.

## DISINFECTANT VALUE OF METAPHEN

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# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

STATED MEETING HELD MAY 14, 1930

The President, DR. EDWIN BEER, in the Chair

### BILATERAL BREAST CARCINOMA, OF LONG DURATION

DR. CHARLES E. FARR presented a woman, who in March, 1913, then forty-nine years of age, was admitted to the New York Hospital on account of a small tumor in the left breast which had first been noticed shortly before her admission. This tumor was hard, attached slightly to the skin but apparently not to the deep fascia. No axillary nodes were palpable.

A radical mastectomy of the left breast was performed, including the muscles and the axillary contents. Recovery was uneventful. She was discharged practically healed on April 9, 1913.

The pathological report is as follows:

Reported by Doctor Elser, March 31, 1913.

"Specimen consists of a rather large breast, left side. Three inches to the left of the nipple and on the level of this structure is a slight retraction of the skin. On section the breast shows numerous cysts filled with a grayish black fluid material. At one point corresponding to the depression referred to above there is a nodule irregularly ovoidal in shape, about the size of a pecan nut. Cut section of this nodule presents the typical characteristics of a carcinoma.

"Frozen sections made from this area confirm the diagnosis.

"The case is of special interest in that, according to the history, the opposite breast, it is claimed by the patient, developed a tumor some years ago which subsided without treatment. This suggests either a cyst formation or a mastitis in the opposite organ.

"Examination of the axillary contents fails to reveal enlarged lymph-nodes. Sections made from two small lymph nodes which are normal in size fail to reveal evidences of metastases."

This woman again entered the hospital February 20, 1925, complaining of a tumor in the right breast, which a few weeks before admission she first noticed.

Physical examination revealed scar of the left mastectomy. In the upper outer quadrant of the right breast was a discrete mass the size of an egg, which was adherent neither to skin nor underlying tissues. Nipple was not retracted. No axillary enlargement demonstrated. February 21, 1925, a radical mastectomy of the right breast was performed, including the axillary contents and the muscles. Again, the recovery was without incident.

The pathological report is as follows: Reported by Doctor Beattie February 25, 1925.

"Specimen consists of a moderate-sized fatty breast with a mass of induration about 2 centimetres in diameter at its outer border. On section this mass shows an irregular growth of yellowish white tissue, firm in texture, extending irregularly into the fatty tissue of the breast. In the attached muscle and connective tissue are found several hard lymph nodes varying in size from 3 millimetres to 1 centimetre in diameter. Microscopic section shows the picture of a carcinoma. The epithelial cells lie in irregular cords and nests and show hardly any tendency to form alveoli. There is a good deal of scar-like stroma. Section of lymph nodes shows inflammatory hyperplasia of sinus endothelium; no evidence of tumor metastases.

## ECHINOCOCCUS CYST OF LIVER

"Microscopic section of lymph nodes shows proliferation of endothelial cell lining sinuses, but no evidence of tumor metastases is seen."

The woman has remained in excellent health generally since this last operation and has no evidences whatever of recurrence or metastases. She never had any radiation treatment of any sort.

The slides made from the tumors in this case were reviewed by Dr. Lawrence W. Smith, of the Pathological Department of the New York Hospital in April, 1930. He was able to find a block of the tissue preserved in this case and to make a supplementary slide for further study. This study concurs in the original report of an extremely scirrhous carcinoma of the breast with infiltration of the fat tissue. The lymph-nodes show no evidence of tumor metastases.

## ECHINOCOCCUS CYST OF LIVER

DOCTOR FARR presented a woman, fifty-three years of age, who entered the New York Hospital in the service of Doctor Conner, October 25, 1929. Her chief complaint was pain in the hypochondrium, chills and fever. Her past history was of no bearing, except that for the past five or ten years she had had occasional attacks of pain in the left hypochondrium. These attacks came on every four or five months and lasted three to four days. They were accompanied by severe frontal headaches, but without visual symptoms. There was no jaundice, no vomiting in the attacks, but nausea was present occasionally. There was no radiation of pain to the shoulder or the scapula. There was a slight tendency to constipation. The last attack began three days before admission with severe pain in the left hypochondrium, radiating to the right hypochondrium, but not to the shoulder or scapula. There was slight jaundice, but no nausea or vomiting. There was no hæmaturia or dysuria. On the morning of admission she had a fainting attack of five minutes' duration.

Her temperature on admission was 104° F., pulse 124, respiration 44. The patient seemed stuporous, almost comatose. She was so obese that examination was almost useless, but there was a definite and rather marked tenderness in the left hypochondrium extending moderately to the right hypochondrium.

On the date of admission the leucocytes were 27,300 with 91 per cent. polymorphonuclears and 6 per cent. lymphocytes, 1 per cent. large mononuclears and 2 per cent. transitionals. There were no eosinophiles.

Operation was advised under the provisional diagnosis of acute pancreatitis. Under spinal anæsthesia with spinocain, a long right rectus incision was made. There was a small amount of free fluid. The gall-bladder was enlarged and thickened but contained no stones. In the left lobe of the liver posteriorly was a huge multicystic mass, much larger than a grapefruit, with many cavities, some of which seemed to communicate. The approach through the gastro-hepatic omentum was exceedingly difficult because of the great depth. An attempt at aspiration was negative. Finally packing was introduced and the largest of the cysts was incised. A large number of daughter cysts at once protruded. It was impossible to bring the cyst wall to the parietal peritonæum. The opening was therefore enlarged and about four ounces of daughter cysts, sac wall and membrane were sucked out. The cysts were further broken up with the finger and many more evacuated with the sucker. A large rubber tube was sutured into the cavity. Iodoform gauze packed around this and a Gibson-Mikulicz tampon completed the packing.

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The patient left the operating room in fairly good condition. It was deemed impossible to treat this cyst by the injection of formaldehyde because of the great depth and the many individual cysts. Recovery was very tedious and stormy with many relapses of temperature, but there was gradual improvement after about three weeks and then another relapse for five or six days.

November 25, the patient was again removed to the operating room and under spinal anaesthesia an Israel incision was made in the left flank. The left lobe of the liver was freely exposed, but no evidence of renewed cyst formation could be found, nor any cyst wall which could be attacked. This wound was closed in part and drain inserted. It healed without any evidence of ever communicating with hydatid disease.

The patient left the hospital on the 13th of January, 1930, nearly three months after the primary operation, still with a discharging sinus. She has improved slowly in general health. Her wounds are healed. She has no symptoms. There is a beginning herniation in each of these unsutured wounds.

Doctor Farr then presented (through the courtesy of Doctor Langworthy) the statistics of echinococcus cyst of the liver shown by the First Surgical or Cornell Division of the New York Hospital, service of Doctor Gibson.

*Occurrence.*—In this series of seven cases of echinococcus disease of the liver, four of the patients were males and three were females. All were adults, the ages ranging from nineteen to fifty-three years, five being between twenty and forty. All were of foreign birth or had lived for many years abroad, two being Greek, two Italian, one Turkish, one Armenian and one Austrian.

*Symptoms.*—In every instance, the symptom which led the patient to seek treatment was pain in the upper abdomen. The pain was said to be constant in some cases and intermittent in others; it was usually dull in character and confined to the upper abdomen. This symptom had been present, at least intermittently, for several years in four cases (the four oldest patients) but for only two weeks to six months in three cases. That pain may be a relatively late symptom was evident from the extensive disease disclosed at operation in the cases with pain of only a few weeks' duration. The complaint of tumor as well as pain was given in only two of the seven cases, the tumor having been noticed four years before onset of the pain in one instance, and several months after onset of the pain in the other. Difficulty in breathing as well as pain was complained of by only one patient, who subsequently developed a subphrenic abscess.

*Physical Examination.*—Three patients appeared to be in good general condition, two appeared chronically, and two acutely, ill. Two had slight jaundice of the sclerae. A tumor was palpable in the epigastrium or right hypochondrium in three cases and visible as well as palpable in a fourth. Moderate enlargement of the right lobe of the liver, without palpable tumor, was noted in two cases, and in one case (an obese patient with cysts of the inferior surface of the left lobe of the liver) neither enlargement of the liver nor tumor was felt. Slight tenderness was present in the epigastrium or right upper quadrant in five cases, and some degree of muscular spasm in three. The so-called hydatid fremitus was elicited in one case only,



## DISLOCATION OF THE CARPAL SEMILUNAR

this patient having a large cyst close to the anterior abdominal wall. The temperature before operation was normal in two cases, slightly elevated in two cases (99.4°–100.8° F.) and distinctly elevated in three (102.4°–104.2° F.).

*Laboratory Examination.*—Radiographic examination of the abdomen (without pneumoperitoneum) was done in three cases and in these failed to show the presence of a tumor. A leucocytosis was present in four cases, this being slight (white blood cells 13,400) in one instance, and marked (white blood cells 18,500 to 27,300) in three. Of the six cases in which differential count of the leucocytes was made, three showed a slight increase and one a marked increase in the absolute number of eosinophiles.

*Pre-operative Diagnosis.*—A diagnosis of echinococcus disease was made in but one of the seven cases before operation. In two cases no pre-operative diagnosis was recorded, in one case the diagnosis was abdominal abscess, in two cases, cholecystitis, and in one case cholecystitis or acute pancreatitis.

*Surgical Treatment and Results.*—In three cases (all with single cysts) a two-stage operation was performed, an interval of four to five days being allowed between opening of the abdomen and incision of the cyst. Marsupialization and drainage was done in one of these cases, drainage plus irrigation with antiseptics in the second, and simple drainage with a tube, in the third. The first two patients were discharged improved after post-operative periods of twenty-four and forty-six days respectively. The third patient, who had had a severe hæmorrhage from the liver four days after the institution of drainage, died on the eighth post-operative day.

In three cases, laparotomy and incision of the cyst or cysts was done at one operation. One of these patients, with a single cyst, developed a subphrenic abscess necessitating a second operation five months after the first, but was discharged at six months, improved. Another of these cases, with multiple cysts of the inferior surface of the left lobe of liver, was subjected to a second operation one month after the first, with left posterior (Israel) incision to facilitate drainage, but still had slight fever when discharged to the out-patient department on the eightieth day. In the third case, which also had multiple cysts, the largest cyst only was incised and marsupialized. The patient was transferred after twenty-four days to another hospital, where he died about three weeks later.

In one case exploratory laparotomy revealed such extensive disease, and in such an inaccessible location, that surgical interference (other than biopsy) was not attempted.

## DISLOCATION OF THE CARPAL SEMILUNAR

DOCTOR FARR presented a man aged thirty, who entered the New York Hospital March 20, 1930, in the service of Doctor Gibson.

On December 26 he fell 23 feet on his right side and arm. From the time of the accident he was not able to move his right wrist or the fingers. He could, however, move the thumb. There was a marked loss of sensation in the hand. After ten days of home treatment sensation of touch returned, but up to the time of admission there was some numbness and recently

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there was tingling in the fingers and hand. Two weeks before admission his fingers began to show some motion and power and he was able to make a fist. During these three months he never was able to move the wrist, which was kept in a straight and fixed position. In the region of the right carpus there was a painful swelling on the anterior surface over the semilunar bone, and a hollow on the dorsal surface in the corresponding position. All motions were painful and markedly restricted.

March 21 a vertical incision was made on the anterior surface, radial side of the wrist. The tendons were pushed aside. The anterior fragment of the scaphoid was removed. The semilunar lay in its proper bed in the radius but was dislocated from the os magnum. It was therefore removed and the os magnum then reduced with comparative ease. The wrist was put up in hyperextension. Closure with interrupted chromic, silk or skin. The time of operation was thirty minutes.

The X-ray report is as follows: "There is a fracture of the tip of the styloid extending into the joint. There is a disorganization of the proximal row of the carpal bones which seems to consist of a dislocated semilunar and



FIG. 1.—Dislocation of carpal semilunar bone.

fractured scaphoid. The film taken March 24, 1930 shows absence of the semilunar and the proximal portion of the scaphoid. The fractured radial styloid is clearly shown. (See Fig. 1.) Recovery was without incident. There has been fair progress toward return of power and motion.

DOCTOR FARR presented also a man, a laborer, who entered the New York Hospital March 26, 1930, in the service of Doctor Gibson. His complaint was of stiffness in the right wrist. February 18 while at work cranking a truck he wrenched his right wrist. It was painful and there was loss of function with swelling. The pain disappeared in a few days, but the swelling, stiffness and disability persisted. His history otherwise is without bearing.

There was definite limitation of motion in the right carpus, with an obvious deformity in the region of the semilunar carpal bone. There was a definite hollow on the dorsum, corresponding to this spot, and a swelling on the anterior surface. The pain and tenderness were very moderate.

February 27, 1930, an incision was made on the anterior surface toward the ulnar side. The carpal semilunar was found dislocated forward on its transverse axis and rotated laterally on its vertical axis. It was removed with considerable difficulty. The man made an uninterrupted recovery and is now nearing normal range of motion and power.

Doctor Farr stated that he had seen all told about thirty cases of dislocation of the carpal semilunar. One was bilateral. Only one case was seen early; this was easily reduced and the result was perfect. There have been

## FRACTURES AT THE CONDYLES OF THE FEMUR

several late closed reductions, up to three weeks, with good results, averaging 80 to 90 per cent. return of function, and no pain. The results after removal of the semilunar for old unreduced dislocations are also good. No open reductions have been accomplished. Old unreduced and non-operated cases always have considerable disability, about 30 per cent., and pain, especially in bad weather. Nearly all of the cases are complicated by other injuries. Many have been entirely overlooked or treated as sprains. A little more care in the diagnosis and treatment of these apparently simple cases would save much suffering and disability.

## STRANGULATION OF THE UNDESCENDED TESTIS

DOCTOR FARR presented an infant, born January 22, 1930, who was admitted to St. Mary's Hospital for Children on February 12, having developed a strangulated right inguinal hernia six days before admission. At frequent intervals the baby had vomited, especially during the last three days. For two days the parents had noticed swelling and redness along the right groin into the scrotum. This swelling had become much greater and more tense in the past twenty-four hours. The vomitus became very offensive (fecal) and very frequent. No stool for twenty-four hours—very little for seventy-two hours.

The baby was operated on at once. An almost black, malformed testicle was found just below a strangulated loop of ileum in a congenital indirect hernia. The testis had just reached the superficial ring. It was freed from recent adhesions. The loop of ileum was freed and reduced with great difficulty. The sac was ligated and cut away, the cord dissected and testis placed in scrotum, although it seemed completely without circulation. The vessels were short and the testis just reached the top of the scrotum. A Bassini closure was performed without transplanting the cord.

Recovery was very stormy because of difficulty in feeding. Two whole blood transfusions were necessary. On one occasion the testis was exposed by a short incision to determine if it was the cause of the toxæmia. However, the testis seemed viable and was not disturbed. On discharge the infant had nearly regained its birth weight of 6 pounds, 14 ounces, and was in vigorous health.

Doctor Farr stated that this was the sixth case of strangulation of undescended testicle that he had personally operated upon. All the children recovered, although one died several months after operation from torsion of a loop of bowel. The testes were all sacrificed except this one. The diagnosis should be obvious because of the empty scrotal sac. The symptoms are those of partial or complete intestinal obstruction, depending upon the presence of a strangulated loop of bowel in addition to the torsion of the testicle. In two of these six cases there was no proof of torsion. The necrosis apparently followed either excessive pressure from behind or from a torsion which did not appear at operation. A considerable number of cases have been reported of late and in nearly all instances there is either a non-descent of the testis or malformation of the testis, or both.

## FRACTURES AT THE CONDYLES OF THE FEMUR

DR. CONDUCT W. CUTLER, JR., read a paper with the above title for which see page 551.

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### FIBROSIS OF COLON

DR. EDWARD D. TRUESDELL presented a man, fifty-four years of age, who had been in fairly good health until twelve days before his admission to hospital, when he was attacked with acute abdominal pain chiefly in the left lower quadrant, vomiting, diarrhoea alternating with constipation, and blood in the stools. For two months before the beginning of these symptoms he had noticed that he was constipated, quite frequently feeling a desire to go to stool but without result. At the time of his admission patient presented an acute abdomen such as would accompany a partial intestinal obstruction. His condition suggested cancer of the large bowel. Under palliative treatment the acute symptoms gradually subsided. X-rays revealed a linear narrowing of the descending colon and upper sigmoid. Wassermann was negative. Operation was performed November 7, 1929, three weeks after the onset of the acute symptoms. On opening the abdomen the pathology, so far as could be determined, was found to be limited to the descending colon. This had the appearance of a section of garden hose. The wall of the colon was constricted, thickened and dull red. The normal contour of the large bowel was absent, the portion involved having a column-like appearance. The lesion was sharply defined at its upper and lower limits and extended from just below the splenic flexure to the beginning of the sigmoid. The involved area was mobilized and excised and an end-to-end anastomosis performed. Examination of the specimen revealed no evidence of cancer or syphilis. Colon wall was greatly thrombosed, all coats being involved. The mucosa was necrotic in places. There was some fibrosis and infiltration of the colon wall by polymorphonuclear leucocytes. The veins of the mucosa and submucosa were greatly enlarged; the underlying lesion would seem to be more satisfactorily explained as perhaps an arterial one, there being a partial vascular obstruction due to thrombosis or embolism. The convalescence was uneventful; patient has gained in weight, bowels are regular, he has had no pain and declares himself to be better than before operation.

### BENIGN TUMOR OF STOMACH

DOCTOR TRUESDELL also presented a woman, fifty-nine years of age, whose past history had been uneventful, but who for four months past had suffered with what was considered to be "gall-bladder trouble." Three months before she had had an attack of acute pain in the upper abdomen, radiating to the right shoulder, with nausea, vomiting and slight subsequent jaundice. There had been persistent digestive disturbance. X-ray showed a faint gall-bladder shadow, which seemed to favor the suspicion pointing to trouble in the gall-bladder. At operation, January 11, 1930, the gall-bladder was found to be small, but not obviously diseased. No stones could be determined to be present in the biliary tract. A tumor was felt in the region of the pylorus which seemed at first to indicate the presence of malignancy. The tumor was found to be situated on the posterior wall of the stomach near the pylorus and projecting above the lesser curvature, being behind the anterior layer of the gastro-hepatic omentum. Division of the gastro-hepatic omentum uncovered a small round tumor resembling a subperitoneal fibroid. Tumor was attached to the posterior wall of the stomach but was readily enucleated, much as a subperitoneal fibroid is enucleated from the wall of the uterus. Tumor was  $2\frac{1}{2}$  inches in its greatest diameter and approximately an inch and a half in each of the other two. Pathological report showed the lesion to be a leiomyoma with some areas of myxoma probably derived from the muscle of the stomach wall. The recovery was uneventful and since operation there have been no further attacks of acute pain, there has been improvement in digestion and general health. Case was of interest because of the



## ADENOCARCINOMA OF THE COLON SIGMOID

symptoms first suggested gall-bladder disease and next malignancy of the stomach. Benign tumors of the stomach are not so rare as to be removed from consideration in patients with upper abdominal symptoms. While it seems that they occur in less than half of one per cent. of all stomach tumors, they are frequently reported. Groups of cases have been reported by several writers. Men and women are equally affected. Myomas are the most common type of benign stomach tumors. They are usually found in the region of the pylorus and may be sub-mucous, intra-mural or sub-serous, much as are myomas of the uterus. They may cause symptoms in two ways, either by interfering with function of digestion because of their obstruction to the motility of the stomach, or in other cases by occurrence of hæmorrhage. The tumor in this patient was so situated as to easily cause obstruction at the pylorus and at the same time to press upon the bile passage.

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STATED MEETING HELD OCTOBER 8, 1930

The President, DR. EDWIN BEER, in the Chair

## ADENOCARCINOMA OF THE COLON SIGMOID

DR. G. A. CARLUCCI presented a woman, aged sixty-one years, who was admitted March 7, 1926, to the First Surgical Division of Bellevue Hospital with the complaint that the bowels had not moved for six days. She stated that she was naturally constipated but never went more than two days without a movement. This time her bowels had moved on March 1 and since then, in spite of repeated cathartics and enemas, she passed only a little gas and a few particles of fæces. She had not vomited, although she felt nauseated and complained of some pain in the lower left side of the abdomen. She had not passed any blood in the stools at any time. The abdomen is rounded, slightly tense and tympanitic. There is tenderness in the lower half and an indefinite mass can be felt in the left lower quadrant. Vaginal examination is negative and the rectal examination does not reveal the presence of a mass nor blood.

A laparotomy done March 13, 1926, revealed at the lower end of the sigmoid flexure of the colon an annular carcinoma about 3 centimetres long, not adherent to the surrounding structures. In the mesentery of the loop there were only two small palpable nodes felt. No nodes felt retroperitoneally. About 15 centimetres of the colon were removed. End-to-end anastomosis. Wound closed without drainage.

*Pathological Report.*—The resected piece of sigmoid colon was about 13 centimetres in length. On the external surface about 2 centimetres from the distal end is a constricting band which considerably narrows the diameter of the gut and this band feels indurated. The induration extends distally almost to the end of the resected gut. On section there can be seen corresponding to the distribution of the constricting band an annular growth which completely encircles the lumen and which is non-ulcerating. From the gross appearance the growth seems to extend in the muscular layers of the gut to within 0.5 centimetre of the distal end of the resected portion and it extends proximally for about 2 centimetres in the muscular layers beyond the limits of the constricting band. The constricting band proper is about 3 centimetres in length and almost occluded the lumen, the wall of the gut here being over 1 centimetre in thickness.

The microscopical examination revealed a mass of epithelial cells arranged in very definite alveolar formation extending through the muscular layers down almost to the serous surface and separated by dense bands of fibrous tissue.

*Post-operative Course.*—Highest temperature was 101°. She had very slight distention. Two bowel movements on the fifth day post-operative. No blood in stools. The abdominal wound healed by primary intention and patient was up on the eighteenth day.



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She was then referred to the X-ray therapy department where she was given a course of deep X-ray treatments.

She left the hospital weighing 100 pounds and now weighs about 115. She has an occasional attack of constipation but an X-ray taken after a barium enema in May, 1928, shows no pathology four and a half years after operation.

### ACUTE HÆMATOGENOUS OSTEOMYELITIS OF THE HUMERUS

DOCTOR CARLUCCI presented a man, aged twenty years, who cut his left foot on a piece of glass in March, 1926. The wound had become infected when first seen by the reporter about two weeks after the accident. He had an extensive cellulitis of the whole foot. He was taken to the Booth Memorial Hospital where several extensive incisions were made in the foot. The wounds were Dakinized and gradually cleared up so that about the end of April he was discharged in fairly good condition. Just before leaving the hospital he complained of some pain about his right elbow and a slight swelling there was noted. By May 15 he had developed a fairly high fever and a painful swelling of the whole shaft of the right humerus. An X-ray of the arm taken on May 18, 1926, revealed an acute osteomyelitis of the shaft with productive changes in the periosteum. The arm itself by this time was extremely hot, red and tender. He was readmitted to the hospital and under light gas-oxygen anæsthesia two incisions were made on the outer side of the arm and two fairly large drill holes were made in the shaft of the bone. Thick yellow pus was obtained from both openings. The holes were enlarged and then a long spiral probe was passed through from one opening to the other in order to establish through and through drainage. A rubber tube was then inserted in each opening in the bone and through and through irrigations were given, using a weak solution of zonite, every two hours.

He discharged freely from both wounds and apparently was doing quite well when about two weeks after the operation in turning his arm over to examine it the upper part of the shaft was fractured. The arm was kept in abduction on pillows without splints and the irrigations continued.

His general condition improved but he continued to discharge freely from both sinuses. An X-ray taken in July, 1926, demonstrated that union was taking place at the site of the fracture, that a good deal of the shaft was sequestering and that there was good productive reaction along the whole shaft.

October 4, 1926, X-ray showed solid union at the site of fracture and marked thickening of the shaft with areas of rarefaction. By this time he had begun to throw out pieces of the shaft and the lower wound was nearly closed but the upper one still was discharging pus.

He steadily improved thereafter continuing to throw out sequestra mostly from the upper sinus until March, 1927, the lower sinus was closed but the upper one led down to a cavity that apparently would not fill in. This sinus tract and cavity was opened and curetted out and then closed with sutures as there was no pus but just a mass of granulations. The wound healed with very little discharge and no other foci developed.

An X-ray taken November 27, 1927, and one taken September 18, 1930, show the subsequent reestablishment of the contour of the shaft to nearly its normal outline.

This case is reported on account of the severity of the infection, the method of treatment used, the unusual complication of a pathological fracture and the result four years following the operation.

### PRIMARY (?) HODGKIN'S DISEASE OF THE SPLEEN

DOCTOR CARLUCCI presented a woman who when thirty-nine years old was first seen by him about May 1, 1927. She complained at that time of a

## PRIMARY (?) HODGKIN'S DISEASE OF THE SPLEEN

dragging sensation in the left side of the abdomen. She stated that she had had this sensation for the past eight years but that lately it had become worse progressively and it made her very uncomfortable if she stood too long or if she lay down on her right side. Recently she also suffered with nausea and nervousness.

She had not lost any weight and outside of this trouble she did not recollect any illnesses. No disturbance in the menstrual history. She has three grown-up children. She was a fairly well-developed woman in good general condition. In her abdomen could be felt a large mass in the left side that extended from the mid-costal margin downward to the iliac crest, smooth and rounded in contour. No tenderness. No rigidity. Liver edge not felt. No ascites.

Blood count: Haemoglobin 79 per cent.; red blood cells 3,560,000; white blood cells 11,300. Differential: polymorphonuclears 76; lymphocytes 20; basophiles 2; large mononuclears 2. Smear for malarial parasites: negative. Blood Wassermann: negative.

She was admitted to the Misericordia Hospital where the spleen was removed. The splenectomy was fairly easy as there were only a few thin adhesions. After the operation she ran a fairly high temperature for about ten days but this gradually subsided and she healed by primary intention. Two other blood counts taken while she convalesced were 23,200 white blood cells with 88 per cent. polymorphonuclears, and 35,000 white blood cells and 76 per cent. polymorphonuclears respectively.

*Pathological Report by Dr. R. Schleussner.*—Specimen consists of a spleen measuring 28 by 16 by 10 centimetres, weighing 1700 grams. On section it is firm and elastic in consistency, has a smooth surface and shows obliteration of the normal markings. It is dull red in color. *Microscopic Section.*—The Malpighian corpuscles have in large part been destroyed and there is a diffuse fibrosis throughout. The splenic pulp is composed of lymphocytes with a smaller proportion of polymorphonuclears, leucocytes and large Dorothy Reed giant cells. There are no tubercles. *Diagnosis.*—Hodgkin's disease of the spleen.

The slides were also examined by Dr. Douglas Symmers who concurred in the diagnosis.

Following this report the patient was thoroughly examined for any glandular enlargements but none was found. She then went home and remained well for about six weeks when she began to have sever attacks of pain in the pit of the stomach accompanied by vomiting. These attacks would last several hours and then subside. About July 21 the pain became constant, radiating along the right costal margin and so severe that she was readmitted to Misericordia Hospital. At no time was she jaundiced. A cholecystogram taken at this time showed lack of dye in the gall-bladder and suspicious shadows, probably gall-stones. Physical examination was negative except for marked tenderness in the epigastrium. No masses felt.

Her pain persisted in spite of sedatives and she was finally operated on again, July 27. At this operation a very large, thickened gall-bladder was found with one faceted stone lodged near the cystic duct. No stones in the cystic duct but it was surrounded by several thickened lymph-nodes. In removing the gall-bladder severe bleeding was encountered due to two aberrant vessels near the cystic duct. This was controlled with difficulty and some packing was left in besides the cigarette drain.

The patient reacted well following this operation but she drained bile for over two months.

About the beginning of November, 1927, she again consulted the reporter, complaining of lower abdominal pains, frequency and burning of urination.

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Her urine showed only traces of albumen and pus and no blood. Flat X-ray plates of the abdomen revealed no calculi. Vaginal examination showed a mass apparently involving the uterus and possibly the bladder. She was then referred to Dr. I. Kaplan who gave a course of deep X-ray treatments with distinct benefit.

Since then she has had several attacks of pain and swelling over the sacrum but they have been relieved by repeated X-ray treatments. Up to the present she has not developed any enlargement of the superficial lymph-nodes. The last blood count, taken in February, 1930, showed: hæmoglobin 80, red blood cells 4,910,000, white blood cells 27,900, polymorphonuclears 89, lymphocytes 11.

The case was shown on account of the rarity of the diagnosis of primary (?) Hodgkin's disease of the spleen. Although this cannot be positively proven in this case nevertheless there were absolutely no signs of any glandular hypertrophy at the time of the operation.

### PERFORATED ULCER OF STOMACH

DR. FRANK B. BERRY presented a man, sixty-five years of age, who was admitted to Bellevue Hospital February 12, 1925. Well up to one year previously. Since then nausea and epigastric pain several hours after eating. This was relieved by bicarbonate of soda. One and a half hours before admission he had a terrific pain in the right upper quadrant of the abdomen. This pain was constant across the upper abdomen. Past history otherwise negative except for a large, easily reducible, right inguinal hernia.

Physical examination showed a markedly rigid and very tender abdomen, the signs most marked in the epigastrium. Temperature  $100.2^{\circ}$ ; pulse 80 and regular; respiration 24; white blood cells 6,300; 73 per cent. polymorphonuclears; urine negative.

At operation a chronic ulcer,  $1\frac{1}{2}$  inches in diameter, was found with a perforation in its centre. A simple repair was performed; the patient made an uneventful recovery.

Indigestion and epigastric pain continued with diminishing force for about two months. Four months later it reappeared but was readily controlled by soda. One month later, seven months after his operation, he began to do hard manual labor and his pain increased.

He was readmitted to the hospital October 1, 1925. Gastric analysis showed a 600 cubic centimetres' retention of coffee-ground material. Temperature  $98.6^{\circ}$ ; pulse 70 with extrasystoles; respiration 20; urine negative; blood-pressure 140/75. Blood: hæmoglobin 60 per cent.; red blood cells 3,100,000; white blood cells 9,600; polymorphonuclears 72 per cent.

At operation a large obstructing ulcer was found on the lesser curvature. In addition there were dense adhesions binding the whole anterior surface of the stomach to the diaphragm and under surface of the liver. The gastro-enterostomy was found to be well healed and functioning; there was no evidence of the former ulcer. The gall-bladder was large, thick walled, and covered with fibrin. Cholecystectomy was begun but the patient collapsed and his pulse jumped to 140 and was of poor quality. Therefore the operation was limited to a cholecystostomy. Culture from the gall-bladder was sterile. Patient made a good recovery and was discharged symptom-free and with a firm scar January 6, 1928. At that time his blood chemistry was normal.

He was seen in February, 1928, and complained of occasional headaches. These were relieved by medication. In October, 1928, he tried for the police force but was rejected because of his blood-pressure. He has continued to feel well and leads a perfectly normal life. In May, 1930, his blood-pressure

## CONCEALED CANCER OF THE TONGUE

was 230/150 but the non-protein nitrogen in his blood was still normal—33 milligrams per 100 cubic centimetres.

This case was presented because of the unusual combination of conditions—hypertension in a man of twenty-seven, probable duodenal ulcer, and later acute cholecystitis, with relief following both of the surgical procedures.

### PERFORATED ULCER OF STOMACH—RESECTION

DOCTOR BERRY also presented a man, twenty-five years old, who was admitted to Bellevue Hospital August 26, 1925. For the previous six months he had had epigastric pain after meals and some belching. Shortly after lunch on the day of his admission he was suddenly seized with severe epigastric pain. Examination showed a general board-like rigidity of the entire abdomen. No other abnormalities noted. Temperature 98.8°; pulse 90; respiration 44; urine negative; white blood cells 9,200; polymorphonuclears 86 per cent.

He was operated upon about three hours after the onset of his symptoms. A large, indurated ulcer involving the pyloric portion of the lesser curvature of the stomach was found. It was adherent to the neck of the gall-bladder and on its anterior surface was a large rent admitting the tip of the thumb. The stomach itself was small and owing to the great surrounding induration and the friability of the tissues repair by simple means was impossible. Therefore the ulcer was freed from the gall-bladder and the distal 1/3 to 1/2 of the stomach with the ulcer was resected and a Pólya-Balfour type of anastomosis performed. Except for a mild post-operative pneumonia the patient made an uneventful convalescence and was discharged September 16, 1925, symptom-free and with his wound completely healed. In the first months after leaving the hospital he gained 25 pounds. At present, five years later, he eats, drinks and smokes whatever he wishes and drives a truck. There has never been any return of symptoms.

## CONCEALED CANCER OF THE TONGUE

DR. WILLIAM F. McFEE read a paper with the above title for which see page 481.

DR. FRANK S. MATHEWS referred to a case in which cancer of the tongue was not diagnosed until after the appearance of glandular involvement in the neck. The tumor even then was not easily seen on the back of the tongue but an induration could be felt with a central excavation by the examining finger.

DR. CHARLES GORDON HEYD said that in June, 1926, there came into his office a doctor, sixty years of age, with a white, glistening, hard "spot," about the size of the head of a pin, on the under surface of the left side of the tongue, at the junction of the anterior and middle third. On inspection it showed a red border and upon rolling the tongue between the tip of the first finger and the thumb of the right hand a hard, globular tumor could be palpated, approximately 5 centimetres in diameter. This was excised with a cautery knife, together with a wide encircling margin of normal tissue. It was submitted to three well-known and well-qualified pathologists who all reported the specimen as a basal-cell carcinoma. In view of the fact that there was a wide encircling margin of normal tissue, a point that was confirmed by the pathologists, it was deemed advisable to leave well enough alone. The patient had no evidence of recurrence in any way and was examined



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from time to time. In May, 1927, or approximately eleven months after the excision of his lingual neoplasm, he appeared with a mass on the left side of the neck, about 5 centimetres below the level of the tip of the ear and posterior to the sternocleidomastoid muscle. This was superficial and there were no palpable glands between the symphysis of the jaw and this mass. The second neoplasm was excised and on examination by one laboratory was reported as a metastatic epithelioma. Two other pathologists reported a primary squamous-cell carcinoma of the skin and not metastatic. The patient and the specimens were then sent to Doctor Bloodgood, who said in substance that the tongue specimen was apparently one of the youngest cancers he had ever seen, that it was thoroughly removed and there was nothing to fear in so far as recurrence was concerned. On examination of the second specimen of the left upper neck he stated that it was a morphological cancer and not a physiological cancer—that it represented reaction of the skin to chronic irritation; that it was removed on all sides, less markedly underneath, but, he believed, thoroughly, and that there was no connection between the two tumors. It is now over four years since the excision of the lingual neoplasm and over three and a half years since the excision of the cervical neoplasm. The patient has had no recurrence and no disability, and has given no indication of any further trouble. This case indicates what may reasonably be expected when a malignancy in its very beginning is excised.

DR. JOHN DOUGLAS thought the point should be emphasized as to the absolute necessity of doing a biopsy in these cases. The most pathetic instances are those in which carcinoma of the tongue occurs simultaneously in cases showing positive Wassermann reaction, in which so long a time is taken up in treating the syphilis that by the time the lesion is discovered it is inoperable. If biopsy is done in such cases this mistake cannot occur.

DOCTOR MCFEE, in closing, said that fortunately these were relatively benign cases. Otherwise he doubted if the patients shown would be alive today. To him an interesting part of this study was the relatively large proportion of women, fourteen out of seventy or 20 per cent. of this concealed type. It may be as common in women as in men, but as a rule one does not look for carcinoma of the tongue in women, and for this reason it may escape detection in a large per cent. of the cases occurring in women.

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STATED MEETING HELD OCTOBER 22, 1930

The President, DR. EDWIN BEER, in the Chair

STAPHYLOCOCCUS AUREUS SEPTICÆMIA

DR. HAROLD NEUHOF presented a boy, eight years of age, who was admitted to his service at Mount Sinai Hospital four days after the onset of high fever, some pain in the right leg in the region of the knee, and drowsiness. These manifestations had been persistent and progressive. The patient was said to have hurt his leg in some way several days before the onset of the symptoms. On admission the clinical picture was that of a



## ACUTE SUBMAXILLARY SIALADENITIS

severe septic state with high fever, apathy, rapid pulse, slight cyanosis, several petechiae on the forearms, and a palpable, soft spleen. There were physical signs in the chest suggestive of scattered metastatic foci in the lungs. There was a localized swelling, apparently slightly tender, over the upper right tibia, merging into an effusion in the knee-joint. The impression was given of a general septic invasion derived from the limited focus in the tibia, the osteomyelitic focus being no longer the essential part of the picture. Operation consisted of a simple incision and drainage of an abscess between the tibia and fibula, obviously derived from the tibia. No exploration of the bone was made. The administration of continuous intravenous glucose solution was begun and was carried on with little interruption for a period of twelve days. The amount of fluid administered daily ranged from 1000 to 6000 cubic centimetres, being varied according to the condition of the patient. Even on the fifth day after admission the blood culture contained colonies of staphylococcus aureus too numerous to count. Pericardial friction sounds appeared but the process did not go on to effusion. X-ray examination of the chest revealed the existence of bilateral pulmonary infiltrations with several areas of increased density suggesting multiple lung abscesses. These lesions cleared up spontaneously as noted by subsequent X-ray examinations. The patient's condition began to improve on the tenth day after admission although the temperatures still continued at a high level. The blood culture was negative on the fourteenth day. Operation for the osteomyelitis of the tibia was proceeded with when improvement was noted. Pus was evacuated from the bone. Some masses of necrotic bone were removed but no effort was made to clean up the focus entirely. A final operation was done when the patient was convalescent. This consisted in a thorough removal of necrotic bone and the detachment of several sequestra, resulting in deep excavation of the upper end of the tibia. The large cavity was packed. Altogether the patient ran temperatures for a period of six weeks, but the high fever with the general evidence of septic invasion lasted eleven days. After the patient left the hospital a sinus persisted and a revision of the wound has been necessary. Recently pain in the region of the left tibia appeared, lasting a few days. There was no temperature. An X-ray examination revealed a small area of rarefaction in the cortex. This represents a metastatic focus that was in all probability deposited at the time of the acute sepsis. Similar lesions may, of course, crop out at some future time.

## ACUTE SUBMAXILLARY SIALADENITIS (LUDWIG'S ANGINA)

DOCTOR NEUHOF presented three cases of Ludwig's angina: First, a woman, forty years old, who was admitted to the Hospital for Joint Diseases with a three days' history of progressively increasing swelling beneath the chin, swelling in the floor of the mouth, and fever. The tongue was pushed upward and forward so that the patient had been unable to close her mouth for the preceding twelve hours. There was difficulty in swallowing. On physical examination the patient was obviously in great discomfort and breathed with difficulty. There was a diffuse, very obvious, and tender fulness beneath the jaw, more evident on the left than on the right side. Upon pressure over the left submaxillary region pus was noted to escape from the mouth of Wharton's duct. No similar discharge was noted upon pressure on the right side. A free incision was made with an exposure of the left submaxillary gland. Upon removal of the gland by severance of its duct, there was an escape of pus. By following the course of the duct a larger collection of pus was evacuated along the floor of the mouth. The infiltrated tissues were here laid open widely, placing a finger in the mouth beneath the tongue as a guide. The wound was lightly packed. Microscopic exami-

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nation showed an acute suppurative inflammation of the submaxillary salivary gland.

The post-operative plan was to observe the progress on the opposite side and to employ the same procedure here if the lesion was progressive. However, there was rapid subsidence of the sublingual oedema with improvement in motions of the tongue, swallowing, and breathing. As the swelling on the right side subsided, a rounded, tender mass in the region of the right submaxillary salivary gland was felt. Upon pressure over the mass pus escaped from the mouth of the right Wharton's duct. The mass gradually subsided and at the time of discharge from the hospital six days after operation it had almost entirely disappeared. There was nothing unusual in the process of healing of the operative wound. There have been no subsequent symptoms referable to the right submaxillary region.

The second case was in the person of a girl who, when twelve years old, developed a painful swelling in the right submaxillary region during the course of measles. There developed difficulty in opening the mouth, in talking and swallowing, and it was no longer possible to close the mouth completely because of interference by the tongue. When admitted there was a large, diffuse, extremely tender mass occupying the entire right submaxillary region and extending over to the left of the median line. On attempting to open the mouth, the jaw was drawn to the right. The mouth could be opened only a short distance. The tongue was pushed upward by the mass beneath it and there was pronounced oedema of the sublingual mucous membrane. Upon pressure over the submaxillary mass, pus was seen to escape from the orifice of the right Wharton's duct. A free incision was made below the ramus of the jaw. Subcutaneously there was a widespread necrotic exudate. After this was traversed pus was found to escape from various points in the soft parts. A number of completely necrotic lymph-nodes were removed. When the dissection was deepened to the submaxillary salivary gland, most of this structure was firm and infiltrated, fixed by purulent exudate that encased it, and surrounded by small pus pockets. The gland was excised with considerable difficulty. The operative field then looked clean. However, upon following towards the floor of the mouth the probable course of Wharton's duct, an additional necrotic part of the gland was encountered and there was entered a collection of pus under tension that lay directly beneath the mucous membrane of the floor of the mouth. The wound was loosely packed. Microscopic examination of the salivary gland showed the presence of a widely disseminated, acute inflammation. The immediate post-operative course was characterized by a considerable necrosis in the depths of the wound. Injury of the lowest branch of the facial nerve was noted. While the patient was convalescent from the operation, an acute mastoiditis developed that required operation. The patient presents no symptoms referable to the submaxillary operation. Slight weakness in the ability to draw down the lower lip represents the residue of the facial nerve injury.

The third case presented by Doctor Neuhof was a girl who, when seventeen years old, was operated upon on his service at Mount Sinai Hospital for a ranula on the right side of the floor of the mouth. The operator noted that a duct-like structure was excised inadvertently in removing the cystic mass. The next evening difficulty in breathing was noted, the pulse became rapid and patient presented an anxious expression. The following morning there was great difficulty in breathing. The temperature was 101°, pulse 120. There was moderate cyanosis. The mouth could not be closed and the tongue was pushed upward by the swelling of the floor of the mouth. The region of the orifices of Wharton's ducts was in the midst of elevated oedematous mucous membrane that presented several patches of whitish

## ACUTE SUBMAXILLARY SIALADENITIS

exudate. The right submaxillary region was greatly swollen, tender, but the swelling did not extend over the ramus of the jaw. In the left submaxillary region a rounded, tender mass was felt in the region of and interpreted as the acutely inflamed left submaxillary salivary gland. Under a local anæsthesia a free incision was made below the ramus on the right side. Anatomical dissection was difficult because of the extreme restlessness of the patient and the rapidly advancing respiratory difficulty. After the platysma was traversed œdematous tissue was encountered in which a number of enlarged lymph-nodes were embedded. While the dissection was continued to expose the submaxillary salivary gland, the inspiratory stridor rapidly became worse. With one finger in the mouth beneath the tongue as a guide, curved scissors were bluntly introduced into the operative wound and pressed inward toward the finger. Odorless pus escaped. The track made by the scissors was rapidly split open and a finger was introduced which met the finger on the floor of the mouth, mucous membrane being between. The space occupied by the abscess lay along the lateral aspect of the floor of the mouth extending backward toward the pharynx. The wound was loosely packed. Slight improvement in the respiratory difficulty was noted shortly after operation. This was slowly progressive, but tracheotomy was impending for the first twenty-four hours. Thereafter, improvement in breathing was more rapid. The left submaxillary mass slowly subsided. Physical signs suggested the development of a small bronchopneumonic lesion and this was the only post-operative complication. Weakness of the right lower facial nerve indicated operative injury to the branches supplying the lower lip.

DR. RALPH COLP believed the term "Ludwig's angina" was a misnomer. It is not always an angina, and it was first described by Gensoul, of Lyon, in 1836. It was only later, when Ludwig treated the condition in Queen Catherine of Wurtenburg, that the term "Ludwig's angina" became known. It is a condition of phlegmonous infiltration of the alveolar tissues of the floor of the mouth. In the submaxillary region there are three distinct spaces as shown by Poulson, and later demonstrated by dissections in the department of dental anatomy at Columbia, namely the mylohyoid, the submaxillary, and the retromandibular spaces. Over half the cases of "Ludwig's angina" are simply infiltrations of the soft tissues of the floor of the mouth and the submaxillary gland is not involved. The submaxillary gland, however, whether involved or not, acts as a cork to these three spaces, and unless the salivary gland is removed, drainage is impaired. Almost immediately, and certainly within twenty-four hours, after gland removal, the distressing condition is relieved, especially the dyspnœa, and tracheotomy rarely is necessary.

DR. WILLIAM DARRACH asked if Ludwig in his original description of the condition bearing his name, included a suppurative condition of the submaxillary salivary gland. He was under the impression that Ludwig's angina was any phlegmonous condition in the submaxillary triangle. Because of the firm attachment of the deep fascia in this region, suppurative conditions in this part tend to spread to the floor of the mouth and then pass backward to the region of the pharynx and glottis. The subfacial space in the submaxillary triangle is separated from the floor of the mouth in front by the mylohyoid muscle. Behind the posterior margin of this muscle, the only obstruction to free communication between these two regions

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is the submaxillary salivary gland. The greater portion of the latter rests on the mylohyoid and superficial to it. The gland, however, does extend posterior to the margin of this muscle and sends a deep prolongation of gland tissue forward with Wharton's duct on the buccal surface of the mylohyoid. In inflammatory conditions in this region, whether they start in the submaxillary lymph-nodes, superficial to the mylohyoid, or the buccal side of this muscle, that is beneath the floor of the mouth, free drainage of the latter space cannot be established through an incision in the submaxillary triangle unless the salivary gland is removed.

DOCTOR NEUHOF replied that from cursory reading he believed that the general impression held of Ludwig's angina is that it is a phlegmon extending from the floor of the mouth to the soft parts below the jaw associated with elevation and fixation of the tongue, difficulty in breathing and a rapid, often fulminating, progressive course. The customary operative procedure has been free incision or incisions through brawny tissue to the floor of the mouth. Pus is encountered in some cases and not in others. The pathogenesis of Ludwig's angina has been obscure in the case reports he has seen. The condition is not frequently encountered.

Doctor Darrach has described the more commonly met deep submaxillary suppurations requiring the removal of the submaxillary salivary gland in order to obtain adequate drainage of pus foci in that region. Although pus may be found around the submaxillary salivary gland in Ludwig's angina, the removal of the gland does not suffice. It is the first stage in the dissection which should terminate in the opening of the pus pocket between the bed of the submaxillary salivary gland and the floor of the mouth.

Doctor Neuhof believed that his three reported cases give the lead to the pathogenesis of Ludwig's angina. In two of them pus was noted to escape from the orifice of Wharton's duct when pressure was made over the submaxillary swelling. In the third case the etiology was trauma due to an inadvertent removal of a portion of Wharton's duct at the operation for excision of a ranula.

In the first two cases the removed submaxillary salivary gland showed, upon microscopic examination, acute suppurative inflammation. Additional instances will have to be observed to prove that the pathogenesis of Ludwig's angina is an infection of the gland duct system. The findings in the only three cases seen in recent years, however, are highly significant in Doctor Neuhof's opinion and give the lead for a precise surgical approach rather than the free incision method without any definite plan. The mortality of Ludwig's angina is very high and a precise plan of operative procedure may aid in its reduction.

## PYÆMIA FOLLOWING TONSILLECTOMY

DR. HAROLD NEUHOF presented a woman, thirty-six years old, on whom tonsillectomy under local anæsthesia was performed July 15, 1929. There was an interval period of eight days during which she felt well. She then coughed and expectorated some bright blood and this recurred the next day. Eleven days after the tonsillectomy there was a sudden attack of coughing



## PYÆMIA FOLLOWING TONSILLECTOMY

with the expectoration of a large amount of foul green pus. Since that time profuse foul expectoration has continued and there has been constant fever. On admission to Mount Sinai Hospital there were the physical signs and X-ray evidences of a pneumonic infiltration in the right upper lobe in the midst of which a small cavity was noted in the X-ray film. There was little change in the physical signs and X-ray evidences for a month, when the lesion was noted to have progressed considerably and operation was decided upon. In that month's period the patient was treated bronchoscopically. Fever was irregular and the amount of foul sputum was never profuse. The first operation was performed December 13 under local anæsthesia. Portions of the second and third ribs were removed from the anterior chest wall and adherent pleura exposed. Pus was encountered by aspirating a short distance into the adherent lung. The latter was incised and the abscess cavity, lying a few centimetres from the surface, was entered by incision. There immediately followed a terrific hæmorrhage, blood gushing from the wound and pouring out of the mouth. Packings did not control bleeding. A finger was inserted to act as a tight plug and the patient was given a large dose of morphine. After she had quieted down the finger was removed, active bleeding had stopped, and the wound in the lung was tightly packed. The packing was kept in place for a number of days and was removed without any recurrence of hæmorrhage. The abscess cavity was found to be clean. Expectoration of foul pus continued. X-ray examination did not aid in locating additional cavities. For exploration for additional foci, eighteen days after the first operation, more of the second rib and part of the first rib were excised and the underlying adherent lung aspirated. Foul pus was encountered at a considerable depth in the apical part of the upper lobe. The infiltrated lung was laid open to enter the cavity and again active hæmorrhage was encountered, but not to such a degree as at the first operation. The cavity was firmly packed. The patient's condition improved after this operation and the sputum, although profuse, was no longer foul. Upon removal of the packing, the abscess cavity was found to be clean and there was a free bronchial communication. Severe diarrhoea developed, apparently the result of prolonged toxæmia, and was difficult to control. The temperature, normal in the immediate post-operative period, began to present occasional peaks up to  $103.5^{\circ}$ . Although the sputum was no longer foul, it became obvious that additional suppuration existed in the upper lobe. Accordingly, January 28 of this year, lipiodol was introduced into the bronchial fistulæ of the upper and lower wounds on the anterior aspect of the chest. This demonstrated by X-ray a path proceeding posteriorly to a pocket in the posterior aspect of the upper lobe. To reach this abscess in the paravertebral region, a vertical incision was made between the transverse processes of the second and third dorsal vertebræ and the mesial border of the scapula. Portions of the second and third ribs were excised just lateral to the transverse processes. Adherent pleura was encountered. The lung was aspirated through this and a large collection of foul pus was entered. The abscess cavity was laid open freely with relatively little bleeding. The cavity was of large size and was packed and drained. After this operation cough and expectoration progressively diminished. Diarrhoea gradually subsided as the patient's condition slowly improved. There then developed pains in the lower extremities, more marked on the left side, together with paræsthesiæ. These manifestations progressed for several days, reached a peak in about a week and then very slowly subsided. They have never completely disappeared. On examination neither dorsalis pedis was to be felt and the left posterior tibial pulse was absent. The popliteal pulsations were reduced, as were the oscillometric readings. As the thoracic wounds closed down a



path was found between the anterior and posterior entrances into the upper lobe. Through this a silk ligature was carried, the ends being tied over the shoulder. The purpose was to permit the wounds to narrow down but not as yet to close until all evidences of pulmonary infiltration had disappeared. The patient left the hospital in May in good condition and almost symptom-free. Since then she has remained well except for occasional discomfort in the lower extremities. There is still a cough and occasional expectoration of small amounts of mucoid material. The examination of the lower extremities reveals partial return of arterial patency. The maintenance of the track by the silk strand will soon be discontinued because a recent examination of the lower extremities indicates little pulmonary infiltration.

#### PYÆMIA WITH MULTIPLE ABSCESSSES

DOCTOR NEUHOF presented a man, thirty-six years old, who came under observation at Mount Sinai Hospital stating that he had been well until ten days before admission. At that time he began to complain of weakness, sore throat, cough, and pain in the left pectoral region and in the right lower chest. His physician noted a temperature of  $104^{\circ}$  and an injected throat. The next day the patient was up and about, but five days later he complained of generalized pains over the whole body but especially in the left pectoral region and axilla. He was unable to abduct his left arm more than halfway to the horizontal. Shortly thereafter a severe chill followed by high fever occurred and the pain in the left pectoral region disappeared. In the four days before admission there were three additional chills after the first two of which the temperature rose to  $107^{\circ}$ , to rise to  $108.5^{\circ}$  after the third chill. For two days before his admission pain in the middle finger of the left hand was noted. When the patient first came under observation in the hospital, a healed crusted patch was noted on the left thumb. Upon inquiry the patient recalled that there had been a *small blister in this region at the onset of his illness*. He recalled no cause for it and stated that the blister ruptured spontaneously, some cloudy fluid escaping. A blood culture taken shortly after admission was found to be positive, the organism being the hæmolytic streptococcus. During one week's observation the patient had several chills, the high septic temperatures rising on one occasion to  $108.2^{\circ}$ . A metastatic lesion over the right elbow appeared. A tender swelling in the left axilla was noted. At the end of a week the mass beneath the pectoralis became much more obvious upon forcible abduction of the left arm. The sequence of events was thought to be as follows: Infection derived from the bleb on the thumb or possibly some other unrecognized portal of entry on the hand; subpectoral abscess, suppurative phlebitis of the axillary or subclavian veins; septicæmia. A free incision was made that completely traversed both pectoral muscles. A large amount of pus, eight to ten ounces, was found beneath the pectoralis major, sacculated in three pockets lined by gray diphtheritic membrane. The lowest pocket was deep to the pectoral muscle, the second extended upward to the site of the axillary structures, and the third lay above the axillary vessels and nerves reaching to the clavicle. There was a shelf of inflammatory tissue between the two upper collections. This was in the region of the axillary vein. It was traversed, found to contain several acutely inflamed lymph-nodes, and led to the site of the lesion in the axillary vein, whose second portion was expanded, white, and contained a thrombus that could be felt through the unopened thick-walled vein. Further dissection of the vein disclosed an uninvolved first portion proximal to the site of the thrombus. Similarly the lesion tapered off into the third portion of the axillary vein. The wall

## CÆCOSTOMY WITH PROLAPSE OF CÆCUM

of the vein was firmly embedded in dense tissue agglutinating it to the surrounding structures and partly to the axillary artery. The branches of the vein appeared free from involvement. As the complete dissection of the vein was begun a ligature was thrown around the first portion to prevent any systemic invasion from fragments of the thrombus. The excision of the vein proved tedious because of its fixation to the surrounding structures. After the vein was freed it was tied off at its junction with the brachial below and removed in one piece. The specimen showed a suppurating thrombus about 5 centimetres long, broadly adherent to the wall of the vein. Its mesial end was rounded, the distal end rather sharply cut off. The whole wound was widely packed.

After operation temperatures ranged between 100° and 105° for the first week, dropping toward normal with occasional rises in the second week. There was no recurrence of chills. Blood culture became negative. The patient was placed upon continuous intravenous glucose solution begun directly after operation and given without interruption for several days. It was discontinued when the patient showed obvious improvement. A rapidly developing effusion in the right shoulder joint when aspirated revealed pus that contained hæmolytic streptococci. This lesion gradually subsided spontaneously. Several abscesses in the soft parts required incision. The metastatic lesion in the phalanx of the second finger of the left hand subsided spontaneously. A mass in the neck appeared, apparently derived from the hyoid bone, increased in size with some fulness in the pharyngeal wall, and was incised when found to be frankly fluctuant. The post-operative temperature was obviously due to the various abscesses that appeared, and possibly in part to the pulmonary process. From the X-ray examination of the latter it was impossible to determine whether the lesion was pneumonic or referable to suppurative foci. It subsided spontaneously. There was progressive healing of the axillary wound and the patient was discharged after a transfusion given for the anæmia, six weeks after operation. There have been no untoward phenomena since that time and function at the left shoulder is satisfactory.

## CÆCOSTOMY WITH PROLAPSE OF CÆCUM: ILEO-RECTAL ANASTOMOSIS

DR. GUILFORD S. DUDLEY presented a man twenty-eight years of age, who, in 1927, had been submitted to a cæcostomy for the relief of rectal polypi. Since that time all bowel movements had taken place through the cæcal opening and the cæcum had prolapsed about 4 inches from the abdominal wall. For the relief of this condition, he was admitted to Bellevue Hospital March 21, 1930. Examination gave evidence of a chronic ulcerative colitis with stricture of the rectum about 6 inches above the anus. Laparotomy done May 1, 1930, revealed a tight, annular scar tissue stricture of the left colon at the level of the pelvic brim; no other abnormality of intestines or liver was discovered. A lateral anastomosis was made between the terminal ileum and the rectum. After a stormy convalescence, he was discharged from the hospital at the end of seven weeks thereafter. Two months later he was re-admitted. At this time the greater part of his feces were being passed by the normal route but still a considerable amount escaped through the cæcostomy opening. September 15 the prolapsed cæcostomy was dissected free and the ileum separated from the cæcum.

The excess of cæcum was removed and both lumens closed with inverting sutures. It was hoped that the recto-sigmoid stricture was sufficiently patent to allow the passage of whatever mucoid secretion occurred in the excluded colon.

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Convalescence from this procedure was marred only by the twelve to fourteen daily bowel movements per rectum. This frequency was diminished somewhat by the use of bismuth and tincture of opium. He now averages two to three defecations daily; is maintaining his general nutrition well; and despite the fact that he has no colon from which to absorb fluids, insists that he drinks no more water than an average individual. The cæcostomy has remained closed.

### CHOLECYSTOGASTROSTOMY FOR CHRONIC PANCREATITIS

DOCTOR DUDLEY presented also a woman sixty-six years of age, who was admitted to the Second Surgical Division of Bellevue Hospital March 18, 1930. She gave a three weeks' history of upper abdominal fulness and distress; anorexia; "sour stomach" and belching of gas. Three days before admission she experienced sudden sharp pain in the right upper abdomen and on the night before admission suffered an exacerbation of this pain which radiated to the right shoulder posteriorly and was accompanied by vomiting. Examination showed a slight icteric tint to the scleræ and skin; marked tenderness in the right upper abdomen; and a fever of 100°. She was kept under observation for ten days, during which time her jaundice at first increased but later decreased in intensity. On the day of operation very slight jaundice persisted. The laboratory reported a negative Wassermann reaction; a non-protein nitrogen of 38; blood sugar of 82; icteric index of 35; Van den Bergh direct immediate, indirect positive. X-ray after administration of dye showed the gall-bladder faintly visualized but no stones.

At operation March 28, 1930, the gall-bladder was found involved by moderately dense adhesions and its walls considerably thickened. There were no calculi palpable within the gall-bladder or its ducts. The entire pancreas was enlarged, nodular and of very firm consistency. It gave the distinct impression of being carcinomatous. There were no nearby enlarged lymphatic glands nor were there any metastatic deposits in the liver. Recognizing that this pancreatic change might also be the result of chronic inflammation, dependent in turn upon chronic infection within the biliary system, prolonged drainage of the gall-bladder would most adequately meet either situation. As drainage into the intestinal tract seemed more desirable than simple external drainage, a suture anastomosis was performed between the fundus of the gall-bladder and the pyloric antrum of the stomach. Her convalescence was uneventful and she left the hospital on the seventeenth post-operative day. Her subsequent course has been one of continued improvement. She has had no recurrence of biliary symptoms, has remained free from jaundice, and has gained in weight.

DR. HAROLD SANTEE said that his experience with cholecystogastrostomy comprised four cases. He found it satisfactory in cases where there was a question of carcinoma and chronic pancreatitis. If Doctor Dudley would describe the pathological condition representing carcinoma and the one representing simple pancreatitis, he said it would be possible to differentiate them. Occasionally a case presents diffuse inflammation with involvement of the head of the pancreas, and this is put down as chronic pancreatitis. The nodular feel and the complete extent of the involvement in others make one think they are carcinoma. A permanent drainage of the biliary tract would seem to determine the correctness of the solution of the problem. This case of Doctor Dudley's, however, would seem to have been a chronic pancreatitis. Doctor Santee had always been satisfied with the results of cholecystogastrostomy in these questionable cases.

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DR. JOHN E. JENNINGS said that he had had considerable experience with cholecystogastrostomy, and he was not sure he would use it in every case with an indurated pancreas head. In many cases, drainage of the common duct would help to distinguish the morbidity and would relieve the cases of chronic pancreatitis. Doctor Jennings had seen some of these cases going about their work in the third hundred days, carrying small T tubes in the common duct, without any disturbance at all. In similar cases cholecystogastrostomy had not been so satisfactory as far as the gastric disturbance was concerned. The time, however, to decide the question was with the case open before the surgeon.

## MULTIPLE SKELETAL EXOSTOSES

DR. GUILFORD S. DUDLEY presented a man, twenty-one years of age, who first entered the Second Surgical Division of Bellevue Hospital in January, 1930, complaining of a tender swelling on the inner aspect of the lower portion of the right upper arm. He attributed its presence to an occupational injury received one and one-half years earlier. The swelling has not increased in size during this time and he sought treatment merely because of the handicap to his desired activities as a pugilist. Examination showed a walnut-sized, moderately tender, bony, hard swelling, apparently attached to the humerus at the junction of the latter's lower and middle thirds. X-ray showed this swelling to be an exostosis 4 centimetres in length and 2 centimetres in width. January 25, 1930, the mass was exposed and readily removed with a chisel. It appeared to have arisen from the shaft of the humerus on a line with the intermuscular septum between the brachialis anticus and the internal head of the triceps muscles. He was re-admitted to the hospital in September, 1930, complaining of soreness and stiffness in the left thigh after his "road-work," as well as pain and rapid fatigue upon injury to the inner aspect of the arm which had been operated upon eight months before. X-rays at this time showed an exostosis on the lateral aspect of the middle third of the left femur about twelve centimetres in length; a small exostosis just below the mid-point of the shaft of the right humerus (site of the previous operation); and a smaller exostosis on the shaft of the left humerus about 2½ centimetres from the shoulder-joint. The patient had been unaware of this last noted condition. There were no cranial exostoses.

September 22, 1930, the femoral exostosis was removed. It gave every clinical evidence of being identical in structure with the humeral exostosis. At the present time no further treatment is contemplated.

## FRACTURE OF LEG; GAS BACILLUS INFECTION

DR. ROBERT H. KENNEDY presented a man, aged twenty-four, who, December 17, 1924, when eighteen years of age, was struck on the right leg by cardboard weighing 100 pounds. When admitted to the Beekman Street Hospital he presented a large wound at the junction of the middle and lower thirds of the right leg. The X-ray photograph showed also a badly comminuted fracture of the tibia at the junction of the middle and lower thirds with one large, loose piece displaced outward and another inward. There was a transverse fracture of the fibula 3½ inches below its upper epiphyseal line, the lower fragment being displaced backward and inward. Under general anaesthesia a débridement of the wound was done after thorough cleansing and the tibial fracture was reduced manually through the wound. The wound was closed and plaster splints applied.

Within twenty-four hours signs of gas bacillus infection were present



and this was proved bacteriologically. The wound was immediately laid open and Carrel-Dakin treatment instituted. The patient was also given 400 cubic centimetres of tetanus perfringens serum intravenously. During the second day there was no progress of the gas bacillus infection. On his fifth day there was no evidence of gas bacillus infection but there was extensive purulent infection between the muscle planes. The leg was incised widely to above the knee-joint and Carrel-Dakin treatment instituted throughout.

On the twelfth day a Steinman pin was inserted through the os calcis, chiefly for greater ease in dressing the leg, and traction instituted. Up to the end of his fourth week further incision was made every few days for abscess formation. During all this period it was expected that amputation would be necessary. After four weeks improvement commenced and at forty-seven days the tibia showed a large amount of callus. The traction was removed on the fifty-fifth day, although the union was not solid. On the seventy-third day he was allowed up in a chair and by this time had flexion at the knee to 90 degrees. On the eighty-sixth day a secondary suture was attempted for the large open wound over the tibia, but this was only partially successful. The union of the tibia is noted as being solid on the one hundred and third day. On the one hundred and eleventh day Thiersch grafts were applied to the remaining open wounds. He was discharged on his one hundred and thirty-second day with wounds healed, solid union, practically complete motion at the knee-joint and almost no active motion at the ankle-joint. He was walking with crutches and with no splints on. He was bearing full weight at seven to eight months. At fifteen months he returned to part-time work.

January 10, 1929, more than four years after the first admission, he was again admitted to the Beekman Street Hospital with a painful swelling on the external aspect of the heel of five days' duration. This was incised and about one dram of thick pus evacuated. In the depth there was a depression in the os calcis about 1 centimetre deep, being apparently the site of entrance of the Steinman pin. The roughened overhanging bone was curetted away and the wound was entirely healed in two and one-half months and has remained so. Otherwise there had been so sequestration. He had no complaints, no shortening, and no loss of function except that he could dorsiflex the foot to 90 degrees only.

Doctor Kennedy also presented a man, aged thirty-seven, a porter, who was admitted to the Beekman Street Hospital February 20, 1924, at the age of thirty-one. He had caught his right leg between an elevator and its shaft and sustained a compound, comminuted fracture of both bones of the leg in the middle third. He was given a general anaesthetic and after the wound was cleaned it was débrided and a fragment of tibia 2 inches long removed. One end of the tibia was then engaged in the medulla of the other end. The wound was left open, Carrel-Dakin treatment instituted and plaster splints applied.

Three days later gas bacillus infection was evident and the leg was laid open from 2 inches below the knee to the internal malleolus. He also received 400 cubic centimetres of tetanus perfringens serum intravenously in twenty-four hours. The infection was promptly controlled and by the eighteenth day the wound was fairly clean and commencing to epithelialize. He was allowed up in a chair on the twenty-ninth day and commenced to use crutches on the fifty-eighth day. He was discharged on the one hundred and seventh day with union. At present he has no shortening, no deformity of bone and complete function of knee and ankle. The leg is smaller than that of the opposite side. He did not work for one and one-half years at the end of which time his compensation case was settled, giving him 95 per cent. loss



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of leg. His regular work was as a tailor and at the time of the accident he was working as a porter temporarily. He is now employed as a tailor earning more money than before the accident. This patient was shown as a late result in a severe compound comminuted fracture complicated by gas bacillus infection; also because of the method used in locking the fragments. It is of interest to compare the 95 per cent. loss of leg awarded by the compensation board with the late result.

Doctor Kennedy also presented a man, aged thirty-seven, who was admitted to the Beekman Street Hospital May 4, 1927. He had fallen on the sidewalk, sustaining an oblique fracture of both bones of the leg in the middle third, not compounded. The X-ray taken in emergency traction showed good position. There was a spur which seemed likely to engage and hold the fragments in position. The leg was therefore put up in plaster splints. The next X-ray showed that the fragments had slipped and on the fourth day traction by tongs in the malleoli was instituted. On the ninth day the tongs slipped and a Steinman pin was inserted through the os calcis. This was removed on the forty-third day, and plaster splints applied. He was then allowed up on crutches. On his sixty-sixth day the X-ray showed practically no callus and a false point of motion was still present. He insisted on going home and signed a release. The splints were removed four months after injury. He used two crutches up to six months and after nine months walked without a stick. Knee motion was complete at six months and ankle motion at eight months. The pin holes closed before he left the hospital and never gave him any trouble. At one year he returned to his usual work at usual pay. He shows a slight anterior bowing of the tibia with a lump at the site of fracture. There is no shortening, function is perfect and he has no complaints. This case illustrated the common experience in the slipping of oblique fractures and the necessity of more than mere immobilization if healing is to be obtained without shortening.

DR. ROBERT H. KENNEDY then read a paper entitled "Fracture of the Shaft of Both Bones of the Leg. An Analysis of One Hundred and Seven Cases," for which see page 563.

DR. WILLIAM DARRACH remarked with reference to the relative frequency with which Doctor Kennedy had used reduction by plaster and reduction by traction. There were many in this group in which, Doctor Darrach believed, Doctor Kennedy would now use traction. The cases of oblique fracture, where plaster was put on and failed of results and then traction was used, illustrate the experience of many surgeons with oblique fractures. Where traction can be used and watched carefully, one gets better results than from simple reduction and use of plaster. When the ends can be made to engage and lock, the traction method may not be necessary. There are several things that have been learned about traction, by bitter experience, and one is that it should not be considered a method of treatment all by itself, but should be used with manipulation of fragments. Also, if one is going to get reduction by traction, one must get it early. Doctor Darrach believed that with a given fracture, if traction was put on within one hour of the injury, five pounds might bring it down; ten pounds in two hours, or fifteen pounds in six hours. Twelve hours afterward it might take twenty to twenty-five pounds. The result, however, will be much better with a strong pull at the start. Doctor Darrach often starts right away with

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thirty pounds' skeletal traction, and within thirty-six hours reduces it. If the purpose has been accomplished within six to twelve hours, the pull can be reduced, getting down to fifteen pounds as soon as possible. In many cases one can get lengthening but not apposition of fragments with traction alone. Fragment should be replaced by manipulation within twenty-four hours. Traction should be used in connection with old-fashioned manipulation of fragments, either by fingers alone or by pressure from without. What Doctor Kennedy said was true, that traction requires as much attention and experience as open operation—perhaps even more so. With traction one is never done, for constant care must be taken with adjustments.

Another surprising thing was the length of time this group of cases took for solid union. This is more in common with experience than with the textbooks, which speak of getting solid union within six weeks. Experience shows it is more likely to take twelve weeks in spiral fractures, or eight weeks in fractures of the lower third. In most of the textbooks the description of the time taken for solid union is far too optimistic. There was only one point in which Doctor Darrach disagreed with Doctor Kennedy, and that was the way in which he spoke of non-union. He thought it was not fair to talk of non-union until after a year. Delayed union, yes. In severe cases with soft-part injury, the normal time for union may be six or eight months.

DR. DONALD GORDON said that this group of cases demonstrated a cross section of some very conscientiously cared-for cases in this city, from the time of first aid to the time of the follow-up. It furnished a very excellent comparison for men doing fracture work, rather rare at the present time. Most of the complications appear to have been due to damage of the soft parts. They seem to have been handled extremely well. These cases emphasized the need of greater attention to the immediate care of the damaged soft parts. Six or seven years ago, at the City Hospital, the speaker, with Dr. Howard Collins, realized that spiral fractures required traction, but found that the tongs then in use were unsatisfactory. Doctor Collins designed a simple parallel bar device which consisted of two round parallel metal bars nine inches long, which are held apart parallel to each other by two flat metal members eight inches long, also parallel to each other. The flat members cross the round bars at right angles, and are attached to these by four adjustable locking connections. The connections permit separation of the round bars, rotation on their long axis, and a difference in length from the cross member where the traction cord is applied to the pin which enters the malleoli. In one end of each round bar there is a hole at right angles to the long axis which receives a steel pin  $1\frac{1}{2}$  inches long and  $\frac{3}{16}$  inch in diameter. This is held in place by a small thumb screw. This pin has a rounded tip instead of a sharp one (a suggestion of Dr. Kirby Dwight). After a small skin incision is made, a hole is drilled in the outer cortex of each malleolus with a  $\frac{3}{16}$ -inch drill. The blunt pins are introduced, the bars adjusted to the pins and locked in position. The blunt pin does not grove its way out under traction, and cannot penetrate. The adjustment takes care of the superior and anterior position of the internal malleolus,

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and of any discrepancy in the angles of the drilled holes. It permits some movement of the ankle-joint. This device was used with considerable success on a case of intractable spiral fracture. It offers a suggestion for further work on these lines.

DR. JOHN J. MOORHEAD remarked that the Steinman nail was regarded as the best form of skeletal traction. This has been the experience at the Post-graduate Hospital. In regard to the cases of delayed union, in his experience this has occurred more in fractures of the lower third of the tibia and fibula than in any other part of the body. A point of interest was the early reduction accomplished in these cases. Starting reduction when the case is first seen by a staff trained to regard these broken bones as emergency cases, in the same way they regard appendicitis, is very significant. As to the method of estimating the end-results in the Post-graduate Hospital, they had been using for a number of years a method that seemed simpler. Instead of taking the three factors which they have at the Massachusetts General Hospital, anatomical, economic, and functional, the Post-graduate estimates the end-results in terms of function, union, and contour. It remains to give function, union, and contour statistical value. By function is meant capacity to perform, by union is meant the state of repair, and by contour is meant external appearance. By giving statistical value to these, one can come to some sort of numerical value. Therefore function is estimated at 60 per cent., union at 20 per cent., and contour at 20 per cent. If to a patient half his former function is restored, it is estimated at 30 per cent. Half union is put at 10 per cent. and half contour at 10 per cent. The sum of these three would be a 50 per cent. end-result.

DR. SETH M. MILLIKEN said he had used the traction method for years in all cases where maintenance of reduction was difficult. He had seen no damage to the ankle from the use of the pin in the os calcis as muscular function, which was kept up by the balanced traction, promptly restored the joint separation. He emphasized the fact that a maximum weight must be applied at first; that is, sufficiently heavy to reduce the fragments promptly, by distraction if necessary. As soon as over-riding is corrected the weight may be reduced until only sufficient is used to maintain the alignment, the surrounding muscles maintaining the apposition.

DR. KENNEDY, answering Doctor Neuhof's question, said that tetanus perfringens serum had been used in at least twenty-five gas bacillus cases. It was always accompanied by thorough surgical incisions. It had no ill effects and may have had some good ones. It was used sometimes as a prophylactic in cases in which there was a possibility of gas developing. Replying to Doctor Murray, he said that scrubbing in débridement of these wounds had produced no ill effects. They were wounds which were dirty from being dragged in the streets or ground in the bottom of an elevator shaft. When there was no marked muscular injury, an effort was made to get out the dirt rather than cut out muscle. If there was actual dead muscle, that was naturally cut away. Great dependence was placed on thorough washing, irrigating with up to 3 to 5 gallons of fluid.

## BRIEF COMMUNICATIONS

### THIOCRESOL IN WOUND HEALING

FURTHER experience with thiocresol has confirmed the thesis that the sulphhydryl radicle stimulates cell division. The reasons for this and a technic for the use of thiocresol in wound healing were given in a previous communication.<sup>1</sup>

A most important fact in this field is that the new skin covering a recently healed leg ulcer, for example, is very thin, shiny, translucent and delicate. This, coupled with the poor circulation so often in the neighborhood, is a real threat to durable healing. Appropriate methods to aid circulation can be used, such as bandages, elastics, heat, *etc.*, and perhaps central stimulants

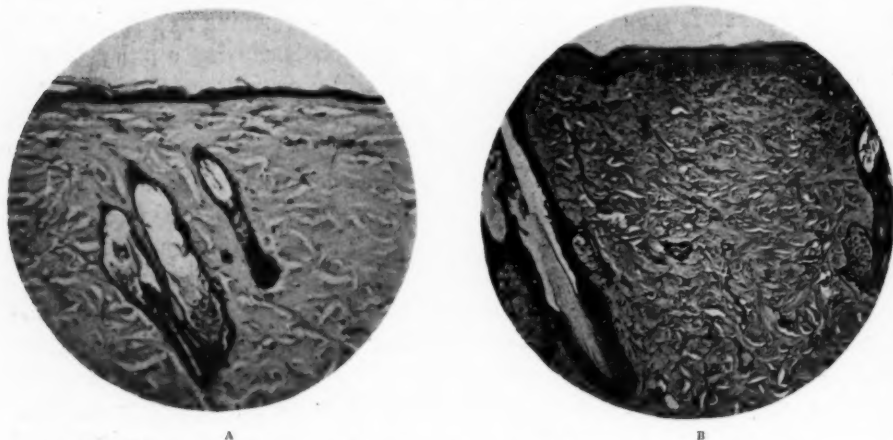


FIG. 1.—A. Skin of left shoulder of albino rat. Painted 3x weekly with 1 per cent. cresol in alcohol. B. Skin of right shoulder of the same rat. Painted 3x weekly with 1 per cent. thiocresol in alcohol. Both photomicrographs of paraffin, H. and E. sections x95.

when necessary. Thiocresol can be used to stimulate the new skin to material thickness. At the same time increase in vascularity occurs beneath.

The evidence for this statement was first obtained in rats and mice.<sup>2</sup> The hair was carefully clipped and various percentages of thiocresol in both alcohol and in lanolin were rubbed on the intact skin. After about six weeks, applications being made three to six times a week, the skin was grossly and microscopically thickened to four and five times normal. (Fig. 1.)

Successful experience to date in humans was obtained in three cases, two of leg ulcer, one of ulcer of the side of the foot. A description of the latter follows:

Mrs. C., now aged thirty years, was injured twenty-one years ago (in 1909) by a heavy weight falling on the outer side of the left foot. A bruise resulted and large vessels were probably severely injured, from the history of the extensive ecchymosis. The part remained tender and sensitive. Fourteen years ago (in 1916), an ulcer



## THIOCRESOL IN WOUND HEALING

appeared which healed several times after rest, skin grafting and other surgical procedures, but only for short periods of time. On examination in May, 1930, an ulcer several years old, 5 by 6 centimetres by 0.5 centimetres, presented a fairly clean, dull brown-red base and hardened, slightly inverted edges. The skin surrounding was pigmented light brown, slightly cedematous, poorly vascular. Treatment with 1:10,000 solution of thiocresol resulted in complete healing in three weeks. The epithelium covering the old denuded area was thin and delicate. The patient was anxious lest a



FIG. 2.—Mrs. C's foot—(d) Line of extent of the ulcer at various times; (c) operative scars; (b) line of extent of the ulcer in May, 1930; (a) thickened skin localized to area rubbed with 0.25 per cent. thiocresol in lanolin.

slight trauma again break the surface. One-quarter of one per cent. thiocresol in lanolin was rubbed in three times a week. In three weeks the new skin was thicker to the touch than the normal skin of the foot, though freely movable over the underlying fascia. Its color and reaction to momentary pressure showed good vascularization. (Fig. 2.)

In using the stronger concentrations of thiocresol in rats and mice, it was noted that a proportion (about 20 per cent.) of the animals developed



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small vesicles and papules on the area treated after about two weeks of applications. Finally scabs, fissures and excoriations appeared. In spite of continued application of the thiocresol, these healed after about two weeks, and the end-results at six weeks in both the animals which developed the eruption and those which did not, were the same, *viz.*, much thickened skins.

Of fifteen laboratory workers who have been in contact with the chem-

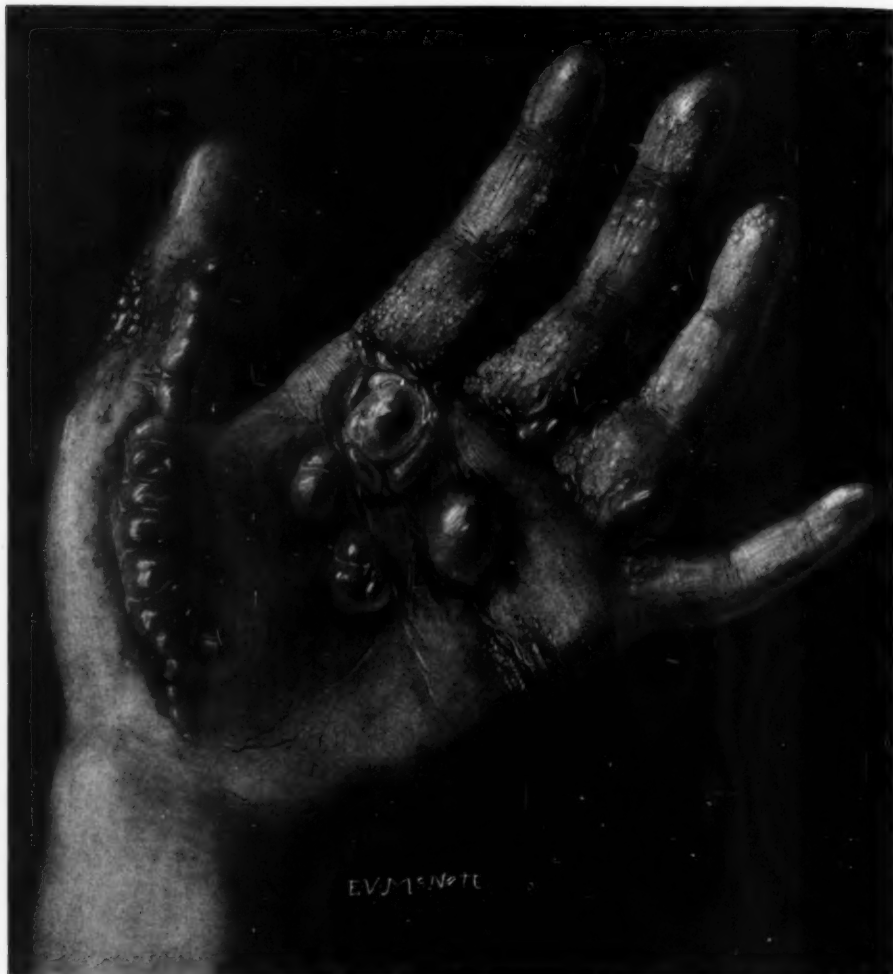


FIG. 3.—Hand of a "sensitive" laboratory worker after exposure to 1 per cent. alcoholic solution of thiocresol. The stopcock broke off a burette containing the solution; it spilled over the hand; was not washed off for some time. Composite picture of a week's duration: the small vesicles like ivy poisoning appeared first and were followed by coalescence to large blebs. Treatment with boric acid ointment containing 0.5 per cent. menthol allayed the itching, and healing took place in about two weeks. This is the extreme case of those observed.

ical, two have shown the same phenomenon. Naturally, in their cases, they were removed from the exposure.

That it was not the organic portion of the molecule, *i.e.*, the cresol portion of thiocresol, which was responsible, is shown in animals by the fact that control applications of equivalent concentrations of cresol to the same

## THIOCRESOL IN WOUND HEALING

animals, on other parts of their skin, at the same time, showed no effects whatsoever.

Also, other sulphydryl-containing compounds produce the same results, *e.g.*, benzyl mercaptan.

In the two laboratory workers and in six patients to date, the untoward reaction can be described as follows: In two patients, the 1:10,000 solution produced the phenomenon (applied three days and seven days, respectively); in the others, stronger concentrations (0.25 per cent. to 1 per cent.) were used but once. Small papules rapidly becoming vesicles appeared on the reddened surface of the skin. They itched intensely and in two cases were diagnosed as ivy poisoning by physicians who knew nothing of the history. The distribution was sharply confined to the area of skin to which the thiocresol was applied. The vesicles coalesced in two to three days to larger or smaller blisters. (Fig. 3.) The itching ceased. The blisters on puncture released a clear yellow serum and healing went on, uninterrupted. Points of difference from ordinary burns are the intense itching and when the blisters were excised, the exposed surfaces were not raw and red, but pink and apparently no more sensitive than the surrounding skin. In addition, stronger alcoholic solutions (up to 5 per cent.) when deliberately applied to the skin of several "non-sensitive" volunteers, produced no caustic effects.

Since it is quite clear that cell-division results depend on concentration, time, and number of applications, we now use 0.1 per cent. thiocresol in lanolin for further experience in thickening the skin. It is very likely the optimum concentration varies with individuals.

Obviously, this "hypersensitivity," so to speak, is worthy of intensive investigation. The theoretical basis and biological significance will shortly be discussed from this institute.<sup>3</sup>

### SUMMARY

Applications of stronger concentrations of thiocresol (0.25 per cent. in lanolin, for example, three times weekly), will cause cell proliferation and thickening of the skin, with increase in vascularity in the subcutaneous tissues.

The skin of a certain percentage of individuals reacts to these stronger concentrations by vesicular eruptions which later disappear.

Weaker concentrations may be better adapted in certain cases.

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## BRIEF COMMUNICATIONS

### APPENDICOVESICAL FISTULA

FOREIGN bodies are considered to be an infrequent cause of appendicitis, especially in America, where the fæcalith is not regarded as a foreign body. A survey of the literature (Mitchell,<sup>1</sup> Fowler<sup>2</sup> and Berger<sup>3</sup>) shows that approximately 2 to 3 per cent. of all cases of appendicitis are caused by true foreign bodies. Mahoney<sup>4</sup> reports a series of seventy-four cases in which foreign bodies were the cause of appendicitis. In forty of these cases the appendicitis was due to the presence of sharp instruments (pins), and the mortality in thirty-eight was 55.2 per cent. In the majority of these cases the appendicitis occurred in childhood, and no history of swallowing the pin could be obtained.

Keen<sup>5</sup> reports the case of a man aged twenty-four, who had suffered from dysuria since the age of seven years. At the onset of the dysuria the



FIG. 1.—Vesical calculus from incrustated pin.

family doctor found a pin in the urethra and removed it. The patient stated that he did not insert the pin into the penis, nor did he remember swallowing it. At the age of twenty-three he was thought to have a rectovesical fistula secondary to the rupture of a prostatic abscess. Two unsuccessful attempts were made to close this fistula. One year later a laparotomy was performed and a long appendix was found, with its distal end incorporated into the bladder wall. The appendix was separated from the bladder and removed, and the patient made an uneventful recovery.

#### CASE HISTORY

The patient, a man aged twenty-six years, entered the clinic on June 17, 1930, complaining that he had been troubled with bladder stones since 1917. He had been treated by irrigations for a very painful bladder, and had been cystoscoped twice with negative findings. The patient states that in January, 1925, he fell downstairs and "jarred a stone loose from the bladder wall." An X-ray picture taken at that time revealed a large stone in the bladder surrounding a pin (Fig. 1). This was removed

## APPENDICOVESICAL FISTULA

from the bladder one week later. The patient did not recall swallowing the pin, but his mother stated that it had been swallowed when he was about six months old.

In January, 1926, a recurrent calculus was removed from the bladder by cystotomy, and in July, 1927, a third stone was removed *per urethram* by means of a lithotrite. During 1927-1928 the patient suffered intense pain with each urination. During the preceding two years he had attacks of chills and fever, and passed gravel and blood in the urine. Several times these attacks were accompanied by pain in the region of the left kidney, and during the preceding month he had noticed a material in the urine that looked like faeces.

X-ray examination revealed no suspicious shadows in the genito-urinary tract. On cystoscopic examination the bladder was found to be very much inflamed. In the posterior portion of the bladder near the top there was a depression which suggested a fistula connecting with the bowel. Considerable faecal material was found in the bladder, suggesting the existence of an enterovesical fistula. In view of the badly inflamed bladder, retrograde pyelograms were not made. Uroselectan was given intravenously, and the urogram showed moderate right hydronephrosis, with a normal ureter.



FIG. 2.—Drawing showing the appendix and its attachment to the bladder.

The left renal pelvis appeared to be normal. The left ureter was visualized, but not well visualized, and was normal. The bladder was small but normal.

The patient entered the hospital June 28, 1930; a suprapubic operation was done on the 30th, under spinal anaesthesia. After the small intestines had been packed off into the upper abdomen. The appendix was found adherent to the dome of the bladder (Fig. 2). The enterovesical fistula was in all probability due to the pin swallowed by the patient in infancy which had lodged in the appendix and perforated the bladder. The appendix was removed from the cæcum, and its distal end dissected free from the bladder wall. The bladder was closed by inverting the wall with two rows of continuous catgut sutures.

The pathologist reported that the specimen consisted of a portion of the appendix which was adherent to and communicated with the bladder. On one surface it was lined by soft, velvety, irregular mucous membrane such as is seen in the bladder. The surrounding portion of the tissue showed dense fibrous adhesions. Opening into the centre of the patch of mucous membrane was a small tubular structure which allowed the passage of a probe. This was the appendix. (Fig. 3.)

## BRIEF COMMUNICATIONS

After the operation the patient made an uneventful recovery, and was discharged in two weeks. A month later he returned to the clinic, reporting that he was free from symptoms. The urine was clear, amber colored, and alkaline in reaction. The specific gravity was 1.020. It contained neither albumin nor sugar, and the microscopic examination of the urine gave essentially negative findings.

In reviewing the literature, only one other report was found of a case of appendicovesical fistula. However, although reports of such cases are rare, the presence of foreign bodies in the appendix is not uncommon.

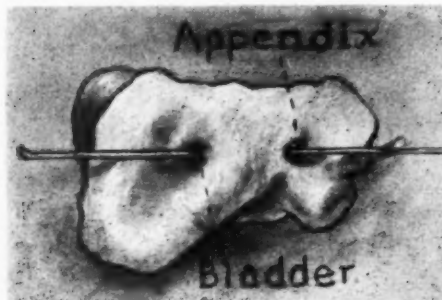


FIG. 3.—The fistulous tract excised showing the connection between appendix and bladder.

Urologists frequently find foreign bodies in the bladder, but it usually is believed that they have been inserted into the urethra, slipped beyond the patient's control, and ascended to the bladder. Once there, they become encrusted with mineral salts and a calculus is formed. When our patient stated that a pin was found in the bladder, we supposed

that it had been introduced through the urethra, but subsequent events in his case led to the belief that the pin swallowed in infancy lodged in the appendix and penetrated the bladder, causing an appendicovesical fistula. The bladder stone with the pin was removed in January, 1925, but the fistula persisted, and was the cause of the re-formation of the bladder stones. Since the removal of the appendix and closure of the fistula the patient has been free from urinary symptoms.

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## SUPERNUMERARY ECTOPIC URETER

THIS case is reported: (1) To record an extremely rare anomaly. (2) To submit the pathological evidence for the first time that this type of



## SUPERNUMERARY ECTOPIC URETER

supernumerary ectopic ureter is explained by persistence of Wolffian body and not by splitting of ureteral analgen. (3) To plead for conservation of kidney to which this structure is attached so intimately that nephrectomy at first seems indicated.

A woman, aged twenty-two years, presented herself, complaining of continuous loss of urine with occasional severe attacks of pain in right kidney region. She was married at nineteen, had a baby at twenty-one years of age. Since birth has continued to have enough loss of urine to necessitate wearing two pads each day. Occasionally she suffered a typical kidney ureteral colic consisting of severe pain in right kidney which radiated into vagina and inner aspect of right thigh. Pain was followed by chills, fever, nausea and vomiting. It was unusual in that a vaginal discharge often occurred during or soon after these attacks. The attacks had durations of from two to eight days and were not relieved by morphia which always made vomiting more severe. Discharge after



FIG. 1.—Injection of accessory tube with sodium iodide.



FIG. 2.—Injection with 12½ per cent. sodium iodide. Showing relation of accessory tube and kidney.

the attack was like "lochia" or "like milk," and continued for about twelve days after the initial escape of about four tablespoonfuls. Her treatment had extended over twenty years and many procedures had been tried, including dilatation of urethral and ureteral strictures for two years, kidney lavage, bladder irrigations, douches, removal of appendix, and fixation of right kidney through a lumbo-lateral incision. None of these procedures seemed to influence the escape of urine, and the attacks of colic were increasing in severity and frequency.

She was a well-developed woman; there was no odor of urine. General examination was negative except for a tender oblique scar of kidney incision. Genito-urinary examination revealed the apparently normal genitalia of a multipara. Uterus and adnexa normal, urethra not remarkable. Posterior to the urethra about two millimetres and about one millimetre to the right of the mid-line between two folds in anterior vaginal wall, an opening not unlike a second urethra was found and entered with a small probe for about one-quarter of an inch. The tract became tortuous or strictured at this point.

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Indigocarmine was injected intravenously and appeared in three minutes in bladder urine; did not appear in excretion from this abnormal opening however.

*Cystoscopic Examination.*—Bladder interior not remarkable except that the trigon seems small, landmarks not well developed. There is a low-grade trigonitis. Ureters

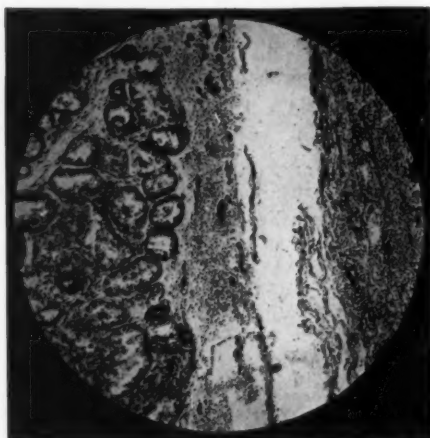


FIG. 3.—Normal kidney adherent but not connected structurally to tube.



FIG. 4.—High power of epithelium and submucosa.

were catheterized, appearance time, phthalein output and urine equal and satisfactory from both kidneys. As catheterization of the abnormal opening in the vagina was not possible, sodium iodide 12 per cent. was injected by means of a urethral syringe into sinus tract and the contrast media was also injected into ureteral catheters simultaneously and X-rayed. The films demonstrated normal kidneys and ureters and in addi-

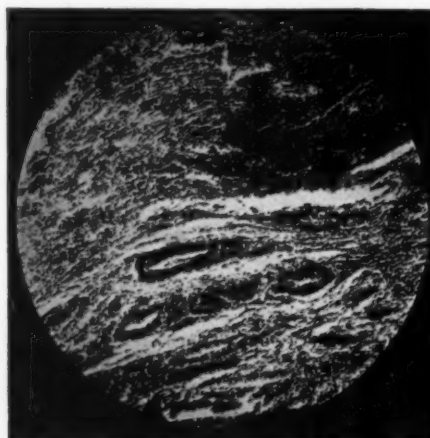


FIG. 5.—Lymphoid nodules and gland-like structures not unlike those found in intestinal tract.

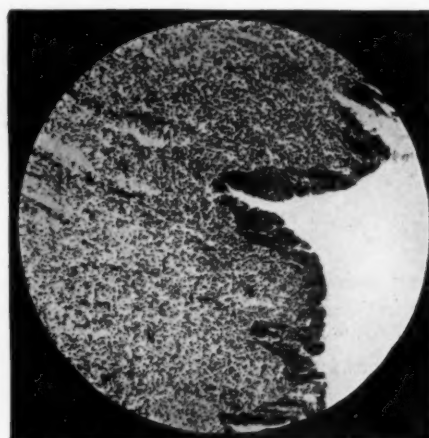


FIG. 6.—Stratified transitional epithelium and low cuboidal epithelium-lined tube.

tion, an accessory tube with a bulb-shaped end internal, posterior, and superior to, the right kidney. The tube wound itself around the normal ureter, crossing it twice as it descended to the vagina where it was very tortuous and showed alternating dilatations and strictures. Injection of this tube reproduced the typical colicky pain of which patient complained. Laboratory findings have never been remarkable though they included Wassermann, blood and urine, and an attempt was made to determine the exact character of fluid escaping from the accessory ureter. The smear did show pus cells

## SUPERNUMERARY ECTOPIC URETER

and diplococci, Gram-negative, coming from the ancestry ureter but fluid could not be identified as urine.

*Operation.*—Through the usual lumbo-lateral kidney incision, the kidney and ureter on right side were exposed. Previous fixation of kidney to twelfth rib made dissection difficult. Normal kidney and ureter were displaced forward and accessory tube about diameter of index finger identified by palpation and aspiration. Upper third of ectopic ureter was dissected from vena cava by clamping many small veins that ran directly to it from vena cava. One large vein which ran directly to the upper pole of kidney was ligated and divided. Upper third of tract was delivered and found adherent to upper pole of kidney, part of upper pole of kidney was resected and left in relation with the accessory tube. Kidney was closed with plain catgut after covering incision in kidney with fat tissue to prevent cutting of stitches and to insure good closure and hæmostasis. Kidney was replaced in fossa and dissection continued toward vagina. The grapevining of the tube around the normal ureter was now beautifully demonstrated. Dissection was continued beyond the brim of the pelvis. Accessory ureter was excised and removed.

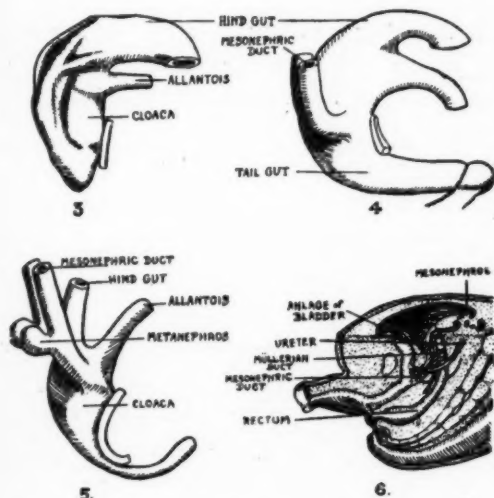


FIG. 7.—3, 4, 5, 6. Various stages in the development of the urogenital system. (After Prentees and Avery.)

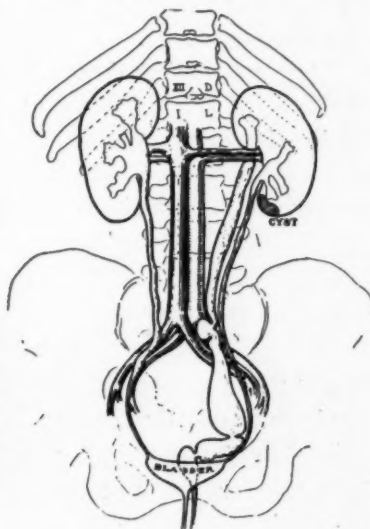


FIG. 8.—Diagrammatic reproduction of structures as found by examination and at operation, showing supernumerary and normal kidney, pelvis and ureters.

Stump was ligated with chromic catgut and cauterized with carbolic acid. Carbolic acid was also injected into lumen of stump to insure sterilization, destruction of mucosa and encourage obliteration. Wound was closed in layers, catgut for muscle, chromic for fascia, silk worm figure of eights for retention and dermal for skin sutures. Two penrose drains were left in wound. Patient made an uneventful recovery.

*Pathological Examination.*—The specimen consists of a long tubular structure measuring twenty-four centimetres in length and from one to two centimetres in breadth. The upper end is bulbous and ends as a blind tube. A portion of kidney tissue is attached laterally to this bulbous end of the tube. The tube walls are thin and lined with mucous membrane which has been stained by methylene blue. The kidney is firmly attached to the tube by adhesions but on section there seems to be no structural connection between the kidney and tube.

Microscopically, the tube consists of several layers, the mucosa, lined with an epithelium that varies from a columnar single-celled layer, as found in the intestinal tract,

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to a stratified transitional epithelium resembling that found in the bladder. In the sub-mucosa, the second layer, masses of lymphatic tissue, also gland-like structures resembling intestinal glands, are found. The remainder of the tube consists of a circular muscular layer and a longitudinal muscular layer surrounded by adventitia. There is a marked inflammatory picture as shown by the small round-celled and plasma-celled infiltration.

Spitzer and Wallin in *ANNALS OF SURGERY* for December, 1928, suggest that embryologically this can be interpreted as a retention of mesonephric tubules and Wolffian duct rather than older explanation of splitting and reduplication of original kidney band on Wolffian duct, and offer the following reasons to substantiate the contention. 1. Gärtner's ducts in females are remnants of Wolffian body and these ureters opened in the position of Gärtner's ducts. 2. Excretion is probably not urine. 3. That pelvis is poorly developed and mesonephrotic structure and not kidney tissue is connected with accessory tube.

They stated that the problem would probably ultimately reach solution should a careful histological study ever be available. We concur in their opinion that this strange body is not a ureter but an adult Wolffian system—a persistent mesonephric duct and Wolffian body, and for the first time, submit pathological specimen and microscopic study to substantiate this interpretation. This investigation reveals: 1. That connection with upper pole of kidney may be by adhesions only and not by collecting tubules. 2. That epithelium may vary from intestinal type of columnar epithelium to stratified transitional epithelium which should not occasion surprise as analgen is derived from cloaca. 3. That mucosa contains intestinal-like glands and lymphatic tissues that suggest intestinal structure.

While reduplication of ureter with unusual implantation is relatively rare, about one hundred cases having been reported, this particular type is *very* rare.

Kilbane in his article in *Surgery, Gynecology and Obstetrics*, January 1926, records two cases in Table IV which probably could be similarly classified had the histological material been available. Full credit should be given to Spitzer and Wallin for indicating necessary study to prove that reduplication of ureter and persistence of mesonephric duct are two distinct entities. The resulting surgical problems are radically different. For reduplication of ureter, ligation, pyelopyelostomy, transplantation into bladder or bowel and heminephrectomy have all been suggested or tried. But in this newly recognized condition, though the picture may be similar the anomaly should be dissected from the kidney and entirely removed. Plea is therefore made for conservation of kidney, though at the time of operation kidney may seem to be structurally a part of Wolffian body.

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## FASCIA LATA FOR OCCLUSION OF ARTERIES

### THE USE OF FASCIA LATA FOR THE OCCLUSION OF ARTERIES IN CASE OF ANEURISM

IN THE ANNALS OF SURGERY of July, 1930, vol. xcii, No. 1, pp. 8-22, J. M. Hanford and J. M. Wheeler, writing about pulsating exophthalmos, are discussing the different methods of arterial occlusion. The great danger of immediate complete and permanent occlusion of the common or internal carotid artery, especially with older people, is too well known to be commented upon. This is why in 1911 Matas and Allen advocated the technic of *partial* occlusion by an aluminum band, which could be compressed completely at a second operation. About the same time Neff reported his method of *gradual* occlusion by placing the artery between the two blades of an aluminum clamp, which are gradually approximated by the traction of rubber bands. With both methods a second operation is necessary; in the first instance, to make the complete occlusion, in the latter, to remove the clamp. H. H. Kerr, in 1925, reported three cases, in which he used with good success a strip of fascia lata for the *partial* occlusion of the common carotid artery for pulsating exophthalmos, after two to four weeks followed by a complete ligation. Thus in all these cases a two-stage operation was done systematically and no use was made of the tendency of the fascial band to shrink, thus gradually producing a complete occlusion out of a partial one; in his second case he reoperated, although after two weeks the subjective and objective signs of the disease were very much diminished after the partial occlusion, which operation might have been unnecessary. This tendency to shrink and produce after a while a complete occlusion out of a partial one is attributed also to the chromicized pig's bladder (Baer's membrane) by Hitzrot and in the case reported by Hanford and Wheeler this seemed to have happened indeed. Especially where an occlusion of the common or internal carotid artery is necessary it is of the utmost importance to give the collateral circulation a chance to develop, that this be done *very gradually*; and it seems to me that the fascial band, on account of its above-mentioned property and because it is tolerated very well by the tissues permanently, is the ideal material to use in these cases. Even if no complete occlusion would ensue by itself, one can make a complete ligation later with much less danger, because the collaterals are in the meantime gradually trained to take over the work.

To illustrate this shrinking tendency of a fascial band, by which an aneurism of the brachial artery with insufficient collateral circulation was cured after a partial ligation, I wish to report the following case:

December 10, 1925, a girl, nineteen years old, consulted me for a swelling at the inner side of the right arm, which had been discovered a few months previously by chance. It had not given her any trouble at all and since then it had not grown perceptibly. As far as she knew no trauma had occurred in this region. Examination revealed an aneurism of the right brachial artery, about four centimetres long and two centimetres in diameter, somewhat below the insertion of the deltoid muscle. The expansile pulsation disappeared when the artery above it was occluded by pressure. The radial pulse was, although smaller than at the other side, distinctly palpable. The reaction of Wassermann was negative. With a palpable pulse in the artery below the aneurism



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one could already predict an insufficiency of the collateral circulation, but for all security the test according to Matas was done, which proved to be negative (no hyperæmic reaction occurred after removing the elastic compression with the artery above the aneurism still occluded).

Under these circumstances a complete and sudden ligation of the artery was certainly courting disaster; in one or the other way we had first to improve the collateral circulation before contemplating this. It then occurred to me that we could make a *partial* ligation of the artery above the aneurism with a strip of fascia lata and thus force the collaterals to do more work and become better developed, after which an extirpation of the aneurism could be done with impunity.

December 11, 1925, I operated under local anaesthesia, removing a strip of fascia lata, six centimetres long and one centimetre broad, from the outer part of the thigh and bringing this under the artery just above the aneurism; the two ends of the fascial band were pulled upward and then a straight artery clamp, catching these between the jaws, and placed parallel with the artery, was pushed up against the artery as far as possible and locked; then a second similar clamp was placed between the first one and

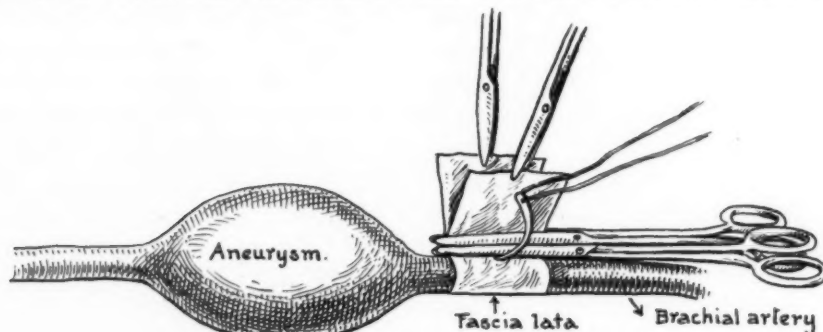


FIG. 1.

the artery, after which the pulsations in the aneurism and radial artery were just palpable; then a round needle with a double silk ligature was brought between the second clamp and the artery, both ends of which, after cutting the loop, were brought back in the same way through both margins of the fascial band and tied securely while the clamps were removed (see the drawing). After ascertaining that the circulation in the arm and hand was sufficient the wound was closed without drainage. For a few days the right arm was kept somewhat elevated and, although the arm and hand felt a little colder than at the opposite side, at no time were there any signs of trouble with the circulation. Ten days after the operation, for the first time, there could not be felt any pulsations in the aneurism or radial artery; about a month after the operation the aneurism had shrunk to about half of its former size and still no pulsation was felt here, but this time the radial artery could be felt pulsating, although faintly, which could in no other way be explained but that the collaterals had developed and brought the blood from the brachial artery above the aneurism through the arteriæ collaterales ulnaris superior-collaterales media and radialis via the rete articulare cubiti and arteriæ collaterales ulnaris inferior and recurrens radialis back to the radial artery. This was further substantiated by the test of Matas which proved now to be distinctly positive. During a few months after the operation the patient complained of becoming tired easily in the right arm, which then felt cold also, but these signs of somewhat impaired circulation soon disappeared altogether and the last time I heard from her about a year ago, she had no trouble at all with her arm, even after playing a strenuous game of tennis. The former aneurism has changed into a small hard (fibrous) nodule.

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## URETERAL ABDOMINAL WALL TRANSPLANTATION

### THE EXPERIMENTAL TRANSPLANTATION OF THE URETERAL ORIFICES TO THE ANTERIOR WALL OF THE ABDOMEN

TRANSPLANTATION of the ureters into the wall of the abdomen provides an easy method for the differential study of renal function in animals, and the difficulties of cystoscopy are obviated. The transplantation may be done in one or two stages. Such preparations are entirely satisfactory if care is taken to prevent subsequent infection of the urinary tract. The chief advantage of the method lies in the ease with which the ureters may be catheterized and with which the intact animal may be studied. Catheters large enough completely to occlude the lumen of the ureter may be employed and hence all leakage about the catheters prevented. Under such conditions quantitative study of the urine can readily be undertaken.

The following technic for the transplantation of the ureters into the

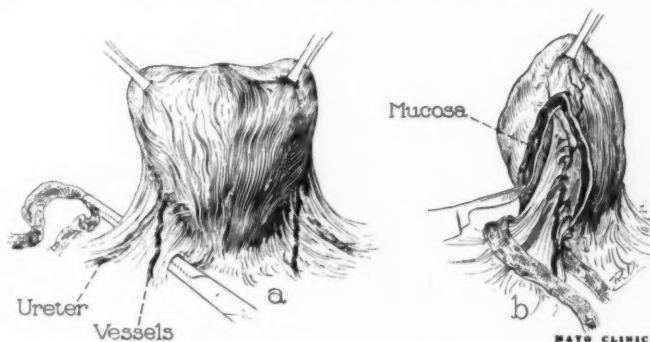


FIG. 1a.—Method of isolating the ureter and the accompanying blood-vessel, and b, sectioning the muscularis.

abdomen of the dog has been so uniformly successful that it seemed worthy of description.

Under ether anaesthesia and with strict regard for asepsis, a median-line suprapubic incision is made. The bladder is delivered out of the wound, and the adjacent viscera and the margins of the wound are carefully protected by packing. An opening is made by blunt dissection through the thin areolar tissues at a point near to the neck of the bladder and immediately subjacent to the ureter which is to be transplanted. A strip of gauze is pulled through the opening. The gauze not only protects the ureter, and particularly its blood supply, from operative trauma, but by exerting traction on the free ends of the strip, the ureter is pulled away from the wall of the bladder, exposing the field for the next procedure (Fig. 1a). The wall of the bladder is then incised with the belly of a scalpel until the mucosa is exposed in such fashion as to outline a rosette of the wall of the bladder, into which both the ureter and vesical artery enter (Fig. 1b). When this area is properly delimited the mucosa is cut through, especial care being taken to bisect the trigone so as to avoid encroaching on the opposite orifice (Fig. 2a). At all times the relation of the blood supply to the segment must be borne in mind, for on its preservation depends the success of the

# BRIEF COMMUNICATIONS

operation. The bladder is then closed by means of two layers of inverting sutures (Fig. 2*b*) and the rosette of the wall of the bladder is carried through a median rectus stab wound without torsion and sutured to the skin after sufficient skin has been removed to accommodate the transplanted piece without tension (Fig. 2*c*). The abdominal wound is closed in layers.

It will be found helpful to insert ureteral catheters as soon as the bladder is opened and the orifices are identified. The transplantation of both ureters is done in essentially the same manner; the neck of the bladder is closed either by ligature or purse-string suture, and the two segments to be transplanted are trimmed on their fundic margins to get rid of the excess tissue, and then are transplanted as described.

The post-operative care is important. The animal must be inspected twice daily. The orifices must be kept free from uriniferous incrustations,

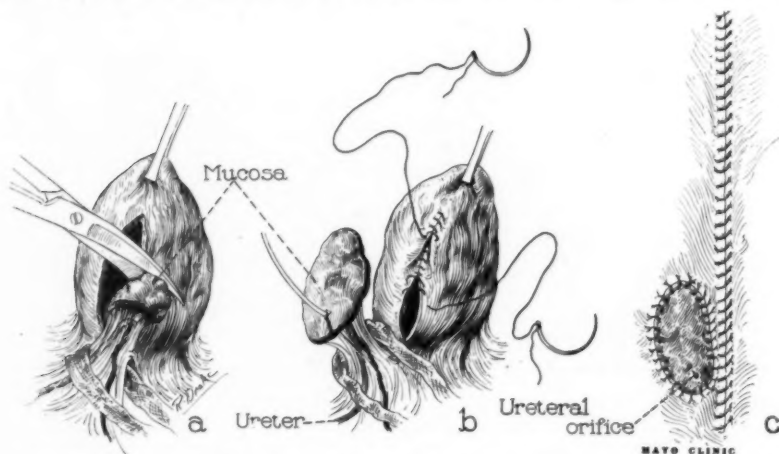


FIG. 2*a*.—Complete isolation of the ureter and accompanying blood-vessel and wall of bladder, *b*, repair of the opening in the bladder; and *c*, the completed transplantation.

and excoriation of the skin must be prevented. The frequent use of physiologic sodium chloride infusion will be found helpful in the resultant flushing of the urinary tract.

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## BOOK REVIEW

DIE AVERTINNARKOSE IN DER CHIRURGIE. BY PROFESSOR W. ANSCHUTZ, M.D., K. SPECHT, M.D., and FR. TIEMANN, M.D., 8vo; cloth; pp. 605. Julius Springer, Berlin, 1930.

The authors have gathered together various data relative to the administration of avertin as an anæsthetic since its discovery by Eichholtz, in 1926, and its first administration rectally by Eckstein of Düsseldorf. The general deduction is that it is unsafe to induce full narcosis with it but that used as a general basic anæsthetic, its exhibition is most satisfactory. The results of several thousand cases are analyzed.

The substance is a tribromomethyl alcohol. It is to be administered in dosage according to the patient's weight, the average being 100 milligrams per kilogram. The dosage will be varied, however, according to the experience of the administrator. Thus, children and young adults will require relatively larger doses than the aged. Obese and debilitated patients and those in whom there is an impaired elimination should also receive smaller dosage.

Its use is contraindicated in instances of severe kidney and liver derangements, in cases of marked arterial hypertension and in cachexia, shock, acidosis and diabetes.

The method of administration of avertin is most simple. The tribromomethyl alcohol is a heavy fluid. The amount elected to be used, usually between 4 and 5 cubic centimetres, is added to distilled water previously heated to 105° Fahrenheit. If the mixture is cooler, the avertin will crystallize. This is then shaken until the drug is thoroughly admixed with the distilled water. The resultant solution is then tested with congo red for assurance that there is no free bromine present which would prove irritating to the rectal mucosa. The mixture is introduced into the lower rectum through a funnel and small rectal tube or syringe. Details of its use by different surgeons such as Nordmann, Kreuter, Butzengeiger, Kohler, B. Martin, Els and Jager, and its use in children by Sievers, are given fully. If greater relaxation is desired, supplemental anæsthesia with ether or gas-oxygen may be employed or local anæsthesia induced. All three of these methods have been employed by the reviewer most successfully.

The patient falls asleep quite naturally in from four to ten minutes usually, the pulse and blood-pressure seldom showing noticeable alteration, the breathing becoming possibly a little more shallow and the face a trifle flushed. Usually, at the end of twenty minutes, the operative work may be proceeded with subsequent to which the patient sleeps normally for five to eight hours, a complete amnesia having been developed during the interim. There is seldom any nausea or vomiting and no period of excitement during

## BOOK REVIEW

either induction or recovery. These aspects of avertin anaesthesia certainly are most desirable and of great importance in justifying its clinical use.

The 103 deaths which have been recorded are not, it would seem, a proper indictment against it as they were, in general, in instances of poor surgical risks and either the result of the employment of an hydrolyzed solution or had received an overdosage. Twelve only can be ascribed to an idiosyncrasy to the drug. From statistics, it would appear to be at least twice as safe as ether and five times safer than either chloroform or spinal anaesthesia.

It appears to be chiefly indicated in elderly people and in children. It has been most satisfactorily employed in severely wounded patients—in moving or undressing them, during direct or X-ray examination, at dressings or during manipulation of fractures. Excellent results have been obtained by its exhibition in tetanus and eclampsia. It lends itself particularly to operations of the head, neck or breast and is ideal in thyroid surgery.

From their experience, the authors conclude that the action of avertin is primarily that of a somatic sedative and not a cerebral sedative, and, as they aptly quote, "Psychische Schonung ist gut, somatische Schonung ist besser!" Thus it would seem that its effects might be enhanced by scopolamine or some barbituric acid derivative as an adjuvant.

The efforts of the authors to place the consideration of the question of rectal anaesthesia by use of tribromomethyl alcohol (avertin) on a sound basis through this publication of their experiences and those of other is quite justified and indicates that we have added to the present well-recognized list of anaesthetic drugs another which comes nearest to giving the profession an easily administrable agent which will cause a perfect induction of anaesthesia, without excitement, without preliminary preparation or pre-operative medication and whose post-operative sequelae are minimal.

The place of avertin is essentially that of a basic anaesthetic—full narcosis should not be attempted as that degree is dangerous. The supplemental use of gas, ether or novocain combines, to the highest degree, excellence and safety in anaesthesia, if it is remembered that carelessness will cause not only morbidity but mortality and that its administration should be superintended by a competent observer and anaesthetist.

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